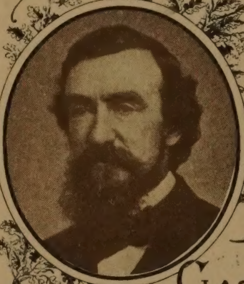
PRACTICAL
COLOR
SIMPLIFIED

by WILLIAM J. MISKELLA, M.E.

350

FRANKLIN INSTITUTE LIBRARY

The BLOOMFIELD H. MOORE



MEMORIAL FUND

CLASS 667.6

BOOK M68

ACCESSION 80041

THIS BOOK IS ESPECIALLY FOR THE USE OF

Advertising Men
Artists
Art Students
Automobile Painters
Automotive Jobbers
Builders
Ceramic Tradesmen
Chemists
Children
Cleaners and Dyers
Colleges
Colorists
Decorators
Designers
Engineers
Enamelers
Factory Managers
Florists
Gardners
Hardware Dealers
Ink Makers
Interior Decorators
Japanners
Lacquerists
Lacquer Manufacturers
Libraries
Manufacturers
Merchants
Painters
Paint Manufacturers
Photo Engravers
Photographers
Printers
Salesmen
Schools
Service Stations
Sign Painters
Teachers
Theaters
Universities
Varnish Manufacturers
Vocational Schools
Window Trimmers

PRACTICAL COLOR SIMPLIFIED

BY

WILLIAM J. MISKELLA, M.E.

CONSULTING ENGINEER ON FINISHES AND FINISHING PROBLEMS

A HANDBOOK

ON

Lacquering, Enameling, Coloring, and Painting
with special attention to
Mixing, Choosing, Harmonizing, Matching, Lighting,
Testing, and Designation

PRACTICAL FINISHING SERIES

VOLUME I

FINISHING RESEARCH
LABORATORIES, INC., *Chicago*
PUBLISHERS

1928

CONS
QC
495
M5
1928

Note—*The cover of this book is water-proof, vermin-proof, and highly resistant to wear.*

PRINTED IN THE UNITED STATES

Oct 12 '28
3.15
Moore

COPYRIGHT
1928
BY
FINISHING RESEARCH LABORATORIES, INC.

All rights reserved, including translation into foreign languages

THE GETTY CENTER
LIBRARY

FOREWORD

It is the policy of the publishers of the PRACTICAL FINISHING SERIES to furnish readers with the very latest and most concrete information on the subject of Finishing. This material is presented in such a way that the reader, even if he is not experienced in looking for reliable information in books and libraries, will have no difficulty in locating the subject matter covering the point in question.

This particular book on *Color* as related to the finishing industry contains all of the general and important information on color choosing, color mixing, color matching, and color harmonizing incidental to practical finishing.

It also contains new information on colored lighting, which is a very important subject for theaters, window trimmers and other experts, and, particularly, for interior decorators, who, in this age of color and the extending use of lacquer, must consider lighting in selecting proper tints and shades for walls and ceilings.

In the volumes to follow, the titles will be chosen according to industries. Thus, the automobile finisher with this book on *Practical Color Simplified* and the book on *Automotive Lacquering* will possess all the up-to-date material available covering his particular field of endeavor.

80041

The publishers and the author join in expressing their appreciation for the kind cooperation and help of those who have aided in various ways in the publication of this book. Readers are urged to offer suggestions which will aid us in improving future editions.

WILLIAM J. MISKELLA

CONTENTS

I

INTRODUCTION 3

Lacquer. Sir Isaac Newton. Wave Length. Color. Shade. The Three General Characteristics. Saturation. Complement. The Lustre. Color Terminology. The Primary Triangle. The Chromatic Circle. The Color Spectrum. The Brightness Cylinder. The Chromatic Cylinder. Tertiary Colors. Popular Colors. Quaternary Colors.

II

COLOR CHOOSING 22

The Procedure. Legibility. Color Range. Color Blindness. Fading Colors. The Harmony Triangle. The Selection of Colors.

III

COLOR MIXING 28

The Use of the Mixing Triangle. Tinting Colors. Color Mixing. Groups. Rules for the Mixing of Colors. Colored Baking Enamels.

IV

COLOR HARMONY 35

Harmony. Associated Combinations. The Basic Facts. The Kinds of Harmony. A Harmony Table. The Sequence of Color Combinations. Three-Color Combinations. Proportion. Names of Harmonious Combinations.

V

COLOR MATCHING 42

Matching. The Circular Scale. Use of the Complementary Color. Using the Complementary Arrow.

VI

COLORED LIGHTING 46

Pigment and Light Color Mixtures. What Red to Choose as a Basis. Colors That Signify Certain Holidays. The Color Art of the Future. Colored Lighting in Show Windows. Colored Light in the Theater. Colored Light in the Home. Colored Lighting of Exteriors. Colored Light and Music. Mercury Arc Lamps. Clear Lacquer.

VII

COLOR PHOTOGRAPHY 58

The Photography of Colors. Photographic Effects of Color Treatment. The Eye of the Camera. Amateur Photographers. Colors That Do Not Photograph Well.

VIII

COLOR LANGUAGE 62

Practical Proof. To Give Personality to Colors. The Color Choosing Chart. The Color Story of the American Flag. The United States Government. The Facts.

IX

COLOR DESIGNATION 70

The Color of Factory Piping. Color Standardization for Factory Surfaces and Equipment. Standard Colors for Sprinkler Heads. The Color Code for Pairs of Telephone Wires.

X

COLOR PIGMENTS 77

Blues. Bronzes. Browns. Greens. Lakes. Leads. Reds. Siennas. Umbers. Vermillion. Yellows.

XI

COLOR TESTING 91

Fastness When Exposed to Light. Ultra-Violet Radiation. Lithographic Colors. Printed Matter. Advertising Appropriations. Dyestuff Colors. Sales Argument Proof of Quality. Housefurnishings. Weathering of a Color. Photographs. Lacquers.

XII

COLOR AND BUSINESS 99

William Shakespeare. The Theater. Poor Returns from Advertising. Personal Preference. Selecting an Automobile. A New Use for Color. Decorative Details. Home Furnishings. The Reward.

INDEX 110

ILLUSTRATIONS

1. Newton's Discovery 6
2. Wave Length 7
3. Wave-Length Scale 8
4. Close-up of Chromatic Wave-Length Scale..... 9
5. Primary Triangle 13
*6. Chromatic Circle 14
7. Color Spectrum 15
8. The Brightness Cylinder........................ 17
9. Tertiary and Quaternary Colors............. 20
*10. Complementary Arrow 23
*11. Mixing Triangle 29
*12. Harmony Triangle 38
13. The Diagonal Theory........................ 40
14. Circular Scale 43
15. Three Actual Photographs of the Chromatic Circle 60
16. Iron Temperature-Color Scale............... 63
*17. Color Choosing Chart 64
18. United States Shipping Board Colored World Map 68
19. A Machine That Produces Standardized Sunlight 96
20. A Weathering Machine........................ 96

*See Color Plate VII for large hand made twenty-five color chart equipped with pivoted devices to aid in color mixing, harmonizing, and so on.

TABLES

1. Tertiary Colors 18
2. Legibility of Color Combinations............. 24
3. Effective Color Range......................... 24
4. Color Grouping 31
5. Colored Baking Enamels...................... 32
6. Harmony Table 37
7. Apparent Effects of Colored Lighting.......... 50
8. Apparent Color under the Mercury Arc........ 57
9. Color Filters 60
10. Color Code for Factory Piping................ 71
11. Color Standardization for Factory Surfaces...... 74
12. Standard Colors for Sprinkler Heads 75
13. Color Code for Pairs of Telephone Wires...... 75
14. Fading of Printing and Lithographing.......... 94
15. Fading of Dyed Textiles...................... 94

COLOR PLATES

I. Pigment and Light Color Mixtures............ 30
II. An Artificially Lighted Automobile Salesroom... 50
III. A Modern Theater 52
IV. A Perfume Light.......................... 54
V. Photographic Effect of Color Treatment........ 60
VI. Popular Color Pigments...................... 78
VII. The Finishing Research Color Chart...........128

TO MY WIFE

I

INTRODUCTION

Lacquer
Sir Isaac Newton
Wave Length
Color
Shade
The Three General Characteristics
Saturation
Complement
The Lustre
Color Terminology
The Primary Triangle
The Chromatic Circle
The Color Spectrum
The Brightness Cylinder
The Chromatic Cylinder
Tertiary Colors
Popular Colors
Quaternary Colors

LACQUER in its modern form has done more toward creating a desire for bigger and better things than any discovery in the world's history. Less than a decade ago, the only colors to be seen on the streets and walls, in stores, show windows, stage productions, magazines, clothing, and so on, were colors closely approaching those of the spectrum.[1] This meant that the possible harmonious color combinations resulting therefrom were confined to a very small number.

An outcome of this lack of variety in color was the creation of a desire on the part of certain individuals to evolve something new and different, and this in a way explains the predominance, up to a few years ago, of certain discordant color combinations. But, with the growing use of lacquer this condition is undergoing a rapid change. The field is open for our existence in a newer and happier color-life, for we have available, not alone the so-called 12 spectrum colors, but literally thousands and thousands of shades, tints, and hues of these 12 basic colors. Perfection in one line of endeavor demands a closer approach to perfection in another. So it is in colors used in the finishing industry. Slowly, but not without a very definite progress, the public is acquiring a certain amount of color education. Color education in clothing and dress is making itself felt in wall decorations and home furnishings, and it is time for us to give a little more attention to color and its characteristics than has been our custom heretofore.

---

[1] See Figure 7, page 15.

The adoption of the primary triangle[2] as a basis for the simplification of color in this book was made with the knowledge that there are other well-founded theories of color. Some of these theories are exceedingly valuable in certain fields; especially where results only are of prime importance and the expenditure of considerable time and money secondary. It is one thing to provide a system, without consideration of expense, whereby colors may be matched accurately, and quite another to provide a simple and inexpensive guide for the practical matching and harmonizing of colors. It is quite apparent, however, that the changes which take place in colors after they are applied, due to varying degrees of light, and the effect of weather, humidity, wind, temperature, chemicals, smoke, dirt and dust in the air, obviously suggest enough variables to call attention to the fact that there is, on the one hand, a very accurate and particular, but likewise costly, classification of colors, and, on the other, a very inexpensive and simple classification. Depending upon the degree of accuracy desired, both systems arrive at the same end. There is a clearly defined field for both systems, but it is the object of this book to supply the basis for a simple, workable, and inexpensive classification. Further, it is a system which is particularly appropriate because the theory used as its basis is the same as that used in teaching color theory in most of the elementary schools throughout the country.

---

[2] See Figure 5, page 13.

It is certain that there is need of a system having a basis which the great majority will understand when trying to coordinate it with the fundamental knowledge of color gained in early school training. For example, attempts have been made, as will be mentioned elsewhere in this book, to create a relationship between color and musical notes. Were anything to be said in favor of this theory, it would be that in music there is a common key or scale, regardless of the geographical location or the language spoken, to which all may turn and be in agreement. This same coordination does not hold with color, for each exponent of a new theory seems to adopt his own basis of measurement.

SIR ISAAC NEWTON in 1666 discovered that a ray of sunlight, when passed through one side of a triangular glass prism, and projected into a darkened room, would result in a beautiful reproduction of the rainbow.

It will be noted. as is shown in Figure 1, that the sunbeam, indicated by the dotted line, will strike the wall at *X*, but when the glass prism is set in place the course of the beam is changed so that it strikes the screen instead and spreads its colored light across it.

From well established data determined by a variety of methods as well as through the use of several scientific instruments, physicists have been able to calculate the number of waves that succeed one another for each of the prismatic colors. Figures 3 and 4 present in graphic form the corresponding wave lengths of each of these colors.

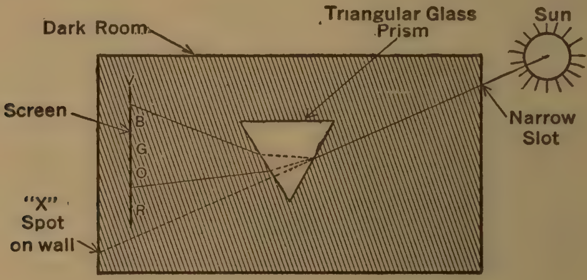


Figure 1.—NEWTON'S DISCOVERY

WAVE LENGTH may be a unit of measurement that is new to many of those who have become radio listeners, but it is a very old term; it has been used by physicists for centuries. In radio, a wave length, the direct or straight-line distance from *A* to *C* (Figure 2), is calculated by dividing 300,000,000 cycles, the velocity per second of electric waves, by the frequency in cycles per second. For example, the wave length of a broadcasting station may be 750 kilocycles, or 750,000 cycles. Dividing 300,000,000 cycles by 750,000 cycles gives the wave length in terms of meters, or 400 meters. Thus, a broadcasting station having a wave length of 400 meters sends out its signal through the air in giant steps measuring 1,312.33 feet in length.

The wave-length scale (Figure 3) tells a story that has been built up as a result of the laborious work of thousands of physicists, radio engineers, and other technical experts over a very long period of time. This scale is especially important in this text, for it shows the relation between the now popular radio waves and the infinitesimal waves of color sensations.

Since new discoveries in one branch of science usually open new channels in others, it is not without the range of possibility to hope that some student will apply the vacuum-tube idea to the direct reading of color wave lengths. Pillsbury[3] has already made a name for himself by photographing the movements of plant life, and has succeeded in showing on a screen 10 feet square the yellow center of a field daisy magnified 100,000 times, thereby disclosing the fact that there is just as much activity in that part of the flower as would normally be seen on a busy street corner. Who can say, after learning of these modern discoveries, that a much needed simple means of identifying colors is not in store for us?

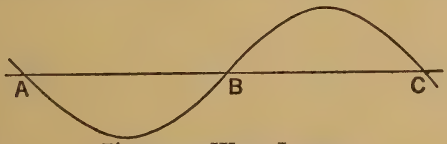
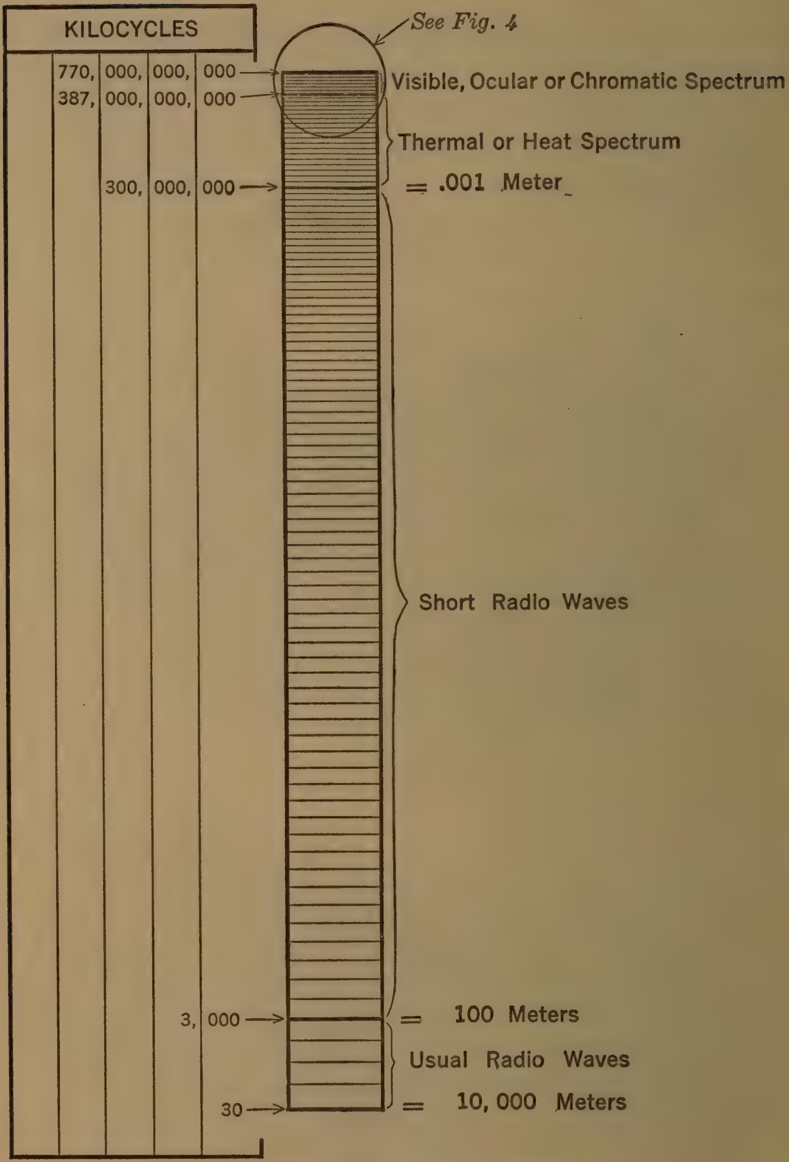


Figure 2.—WAVE LENGTH

---

[3] Official photographer at Yosemite National Park.



Note: 1 Kilocycle = 1,000 cycles per second.

Figure 3.—Wave-Length Scale

The diagram of wave lengths shown in Figure 3 is drawn to scale, and the "close-up" of that portion of it

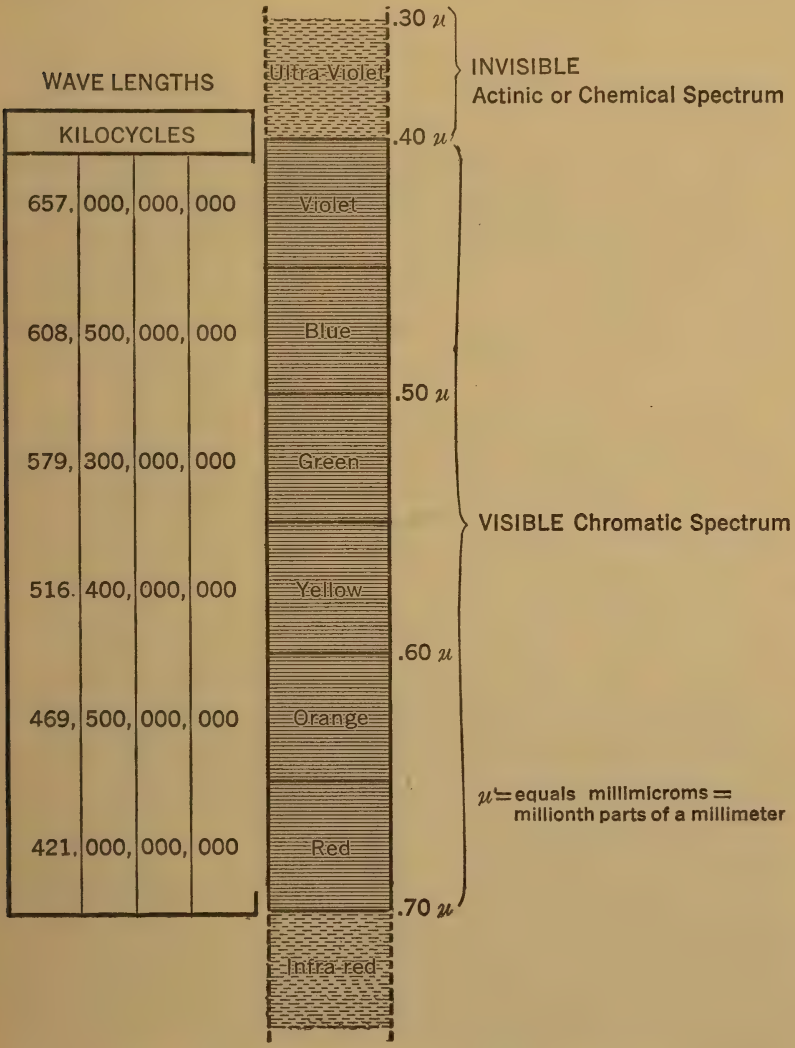


Figure 4.—Close-up of Chromatic Wave-Length Scale

shown in the circle at the top is magnified and reproduced in Figure 4 in order that more detail may be added.

COLOR is a general term. It includes all the colors of the spectrum and all the hues, tints, shades, values, strengths, and intensities thereof which may be produced by their mixture. It involves a definite effect produced by the action of the light upon the retina of the eye, a reaction which is dependent upon the optical composition of the light. This term is also used in reference to material substances such as lacquers, pigments, stains, dyes, and so forth.

SHADE, *also called brilliancy or intensity,* is the brightness term applied to colors that are mixed with black. It is the position in the brightness cylinder[4] between full color and black. This term is used to describe the difference between colors which results from a difference in luminosity only, the other color constants being essentially equal. A darker shade of a color is one that has a lower luminosity. Primarily the term *shade* is akin to shadow, designating darkness or reduced illumination; and, therefore, when strictly used, should express only such changes as depend on reduced luminosity. It has been defined by several authorities as the mixture of black with a color. This establishes its opposite character to *tint,* which is a mixture of a color with white, but by extension of its relative sense it has been frequently and widely used to include lighter shades by use of the adjectives "lighter" and "paler." Although such expressions apparently involve a contradiction it is clear that while we may have a shade of color or a darker color of the same sort it is easy to conceive of another shade not quite as dark.

---

[4] See Figure 8, on page 17.

THE THREE GENERAL CHARACTERISTICS of color are here given. The reader will find the subject of color easy to master if he has a clear understanding of its fundamentals:

HUE. The predominating color in the color mixture. In fact, hue *is* color. It is measured by the circular scale.[5]

BRIGHTNESS. The position between black and white; *tint* is the brightness term that covers colors mixed with white; *shade* is the brightness term that covers colors mixed with black. It is measured by the vertical scale.[6]

STRENGTH. The power of a color. Some colors are stronger than others. This characteristic is measured by the horizontal distance from *gray*—the center of the chromatic circle or cylinder.[7]

SATURATION, or purity, is a measure of the amount of *white light* in the color. White is said to have no hue and zero saturation.

COMPLEMENT, also called contrasting color, can best be explained as a completing color; that is, a color and its complement complete the spectrum. Take *yellow* as the color. Its complement is *violet,* and violet is made of red and blue. Therefore, it is the diametrical opposite in the color circle.[8]

---

[5] See Figure 14, on page 43.

[6] See Figure 8, on page 17.

[7] See Figure 6, on page 14, and Figure 8, on page 17.

In paints and other finishing materials, a color when mixed with its complement produces a gray, theoretically. When complementary colors are placed near or adjacent to each other they appear more intense or saturated. This amplification or increase in contrast produces a more dynamic sensation. This fact makes them valuable for advertising effects and in other instances where it is desired to attract attention.

The above statements apply to saturated (intense or strong) colors. When colors are subdued (often called pastel hue) either by mixing with their complement or with black or white it is much simpler to obtain pleasing color harmonies, and the laws are open to slight modifications. The two classes are of course open to innumerable variations by changing the brightness (value or tone) and the areas of each color.

THE LUSTRE of colored finishes in use at the present time ranges all the way from dead flat to an exceedingly high gloss. Various names are used to describe these degrees of lustre, some of which are as follows: (1) dead, flat, dead-finish; (2) eggshell gloss, semi-gloss, velvet finish, rubbed finish; and (3) gloss, high gloss.

Finishing materials can be had which give these varying degrees of lustre, or one may buy finishing materials which will have full lustre when applied, but which may be rubbed down to secure any desired lessening of the lustre. In other words, the final coat may be one having less than a full gloss, or it may be a high gloss which is afterwards rubbed.

---

[8] See Figure 6, on page 14.

The above refers especially to light colors, such as white, ivory, and the like. Where dark colors are used, better covering is secured, and fewer coats are necessary.

COLOR TERMINOLOGY. Luckiesh, an outstanding scientific authority, states that the three qualities of color are hue, saturation or purity, and brightness, and that these, together with shade and tint, are necessary to complete an effective description. He measures hue

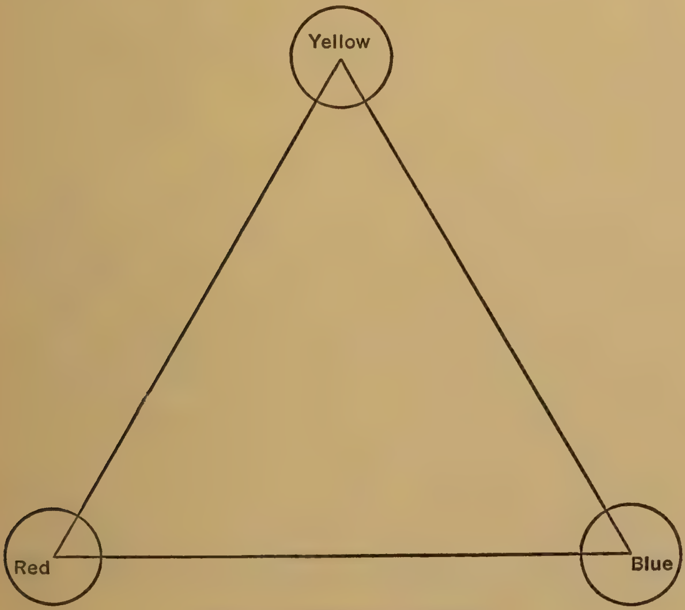


Figure 5.—PRIMARY TRIANGLE

by wave length, saturation by the presence of white, and brightness by a factor called "transmission coefficient" in the case of glass and other transparent materials, and "reflection coefficient" in the case of opaque substances.

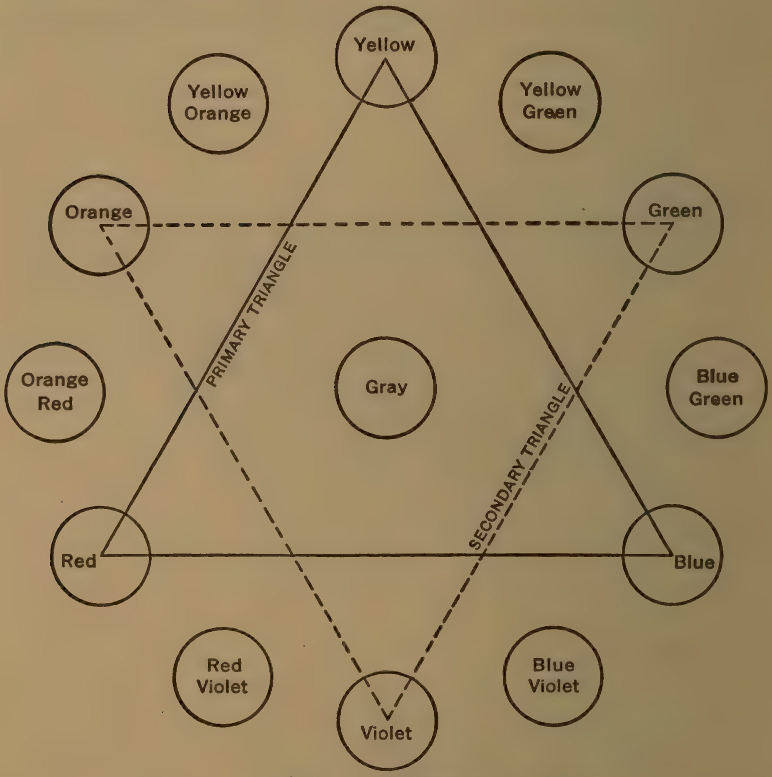


Figure 6.—CHROMATIC CIRCLE

THE PRIMARY TRIANGLE (Figure 5) is the basis of all colors. Its position in the chromatic circle (Figure 6) has been well established.

THE CHROMATIC CIRCLE is a theoretical or imaginary device evolved from the primary triangle. By intermixing the three primary colors, the three secondary colors (Figure 6) are obtained, and by intermixing the *six* colors then available six more are added, as, for example, yellow-green made from yellow, a primary color, and green, a secondary color. It is obvious, then, that if the twelve colors thus made available are intermixed, twelve more will result. Yellow-yellow-green, made by mixing yellow and yellow-green, is an example. This process may be carried out infinitely until a continuous color spectrum similar to the rainbow, with red-violet *added,* is the result.

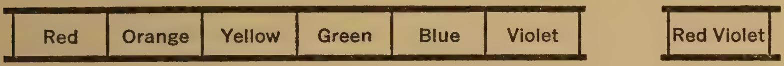


Figure 7.—COLOR SPECTRUM

THE COLOR SPECTRUM (Figure 7) is closely related to the chromatic circle. Let us suppose that a cut is made in the chromatic circle between red and red-violet and that the circle is stretched out into a straight line of colors with red at one end, yellow near the middle, and violet at the other end. That will produce a resemblance of the real spectrum. (*Red-violet,* it should be noted, is not included in the spectrum, but is inserted arbitrarily to complete the twelve-color chromatic circle.) It is the rainbow of pure colors around the chromatic circle from red to violet.

THE BRIGHTNESS CYLINDER (Figure 8) may be looked upon as a set of transparent glass tubes of the diameter of the colored circles placed upon the chromatic circle, lying not on a white background, but upon a glass shelf in a cubical box. This cubical box may be said to be equipped with a roller curtain attached to its top on the front side. Let the position of the chromatic circle be such that violet is nearest the curtain and yellow is farthest away.

Now, as the bottom of the roller curtain is raised from complete darkness, the position adjacent to the bottom edge of the closed cubical box, it passes various imaginary planes. As these planes approach nearer and nearer to the glass shelf, more and more color is added to the black until finally when the zero point, which is even with the glass shelf, is reached, all the black has, for all practical purposes, disappeared and full colors are visible.

Next comes a very interesting and important change, worthy of careful attention. With the eye fixed in a position somewhat above the glass shelf and looking down at an angle upon the chromatic circle, the darker colors of the spectrum appear at first and then as the curtain is raised and more imaginary planes come into partial view, indicating a mixture of white with the full colors, orange-red, gray, and blue-green appear simultaneously, and finally yellow, the lightest of the spectral colors, comes into view.

As the raising of the curtain is continued until the top of the cubical box is reached, an imaginary white plane appears which, of course, signifies such a preponderance of white that all the spectral colors,

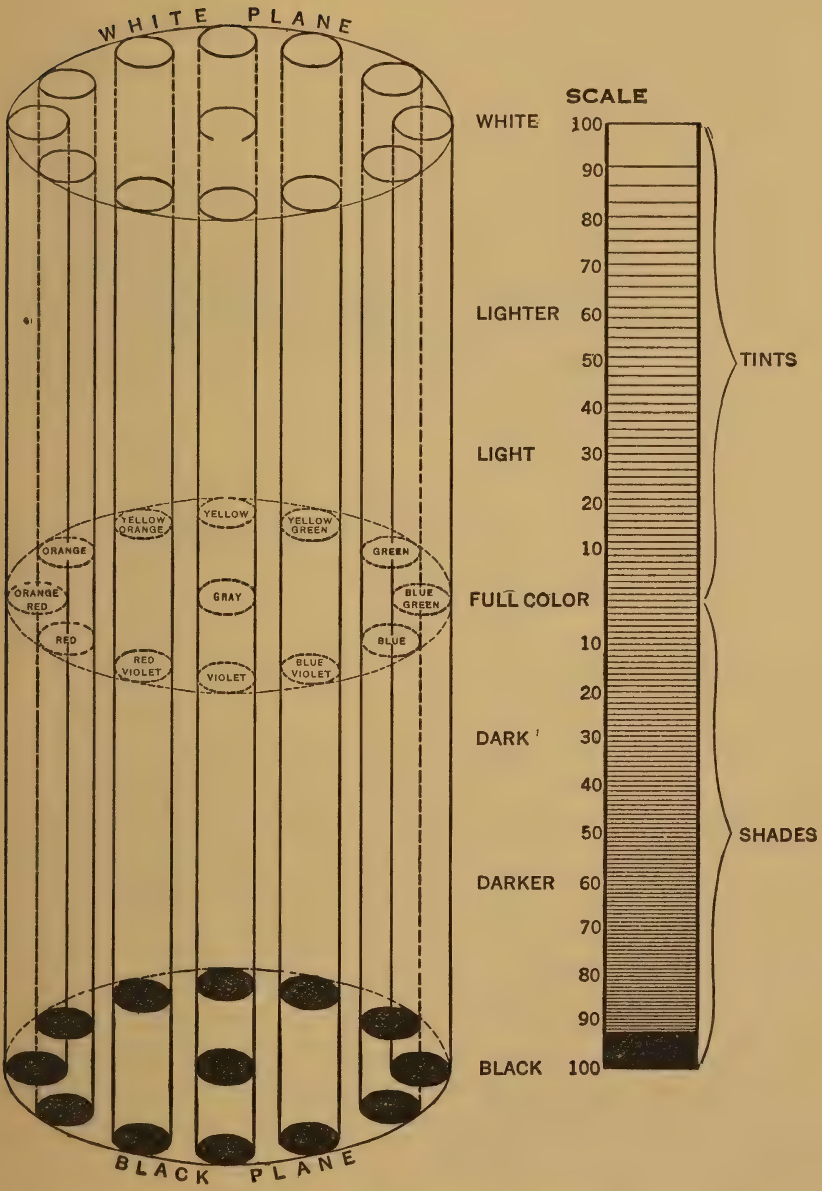


Figure 8—The Brightness Cylinder

although theoretically present, are lost to view. The white plane would correspond to the top or ceiling of the cubical box.

The Chromatic Cylinder comes into being as one of the single color elements of the Brightness Cylinder as, for example, blue-violet. Imagine, if you will, a small amount of blue-violet color in the bottom of the glass tube (Figure 8) with some *white paint* poured in on top of it. As the level of the mixture rises, the *tint* approaches closer and closer to the true white represented by the full white plane.

Table 1
Tertiary Colors

Primary Colors	Secondary Colors	Tertiary Colors	Apparent Temperature
Red Yellow	Orange	Citron	Lukewarm because yellow predominates Make with—4 parts orange —1 part green
Yellow Blue	Green		
Red Blue	Violet	Olive*	Cool because blue predominates Make with—4 parts green —1 part violet
Blue Yellow	Green		
Blue Red	Violet	Russet	Warm because red predominates Make with—4 parts orange —1 part violet
Red Yellow	Orange		

Black and white are not colors. Black is the absence of color, white is the presence of *all* colors. Black and white mixed together produce gray.

*The name *slate* is used by some authorities instead of *olive*.

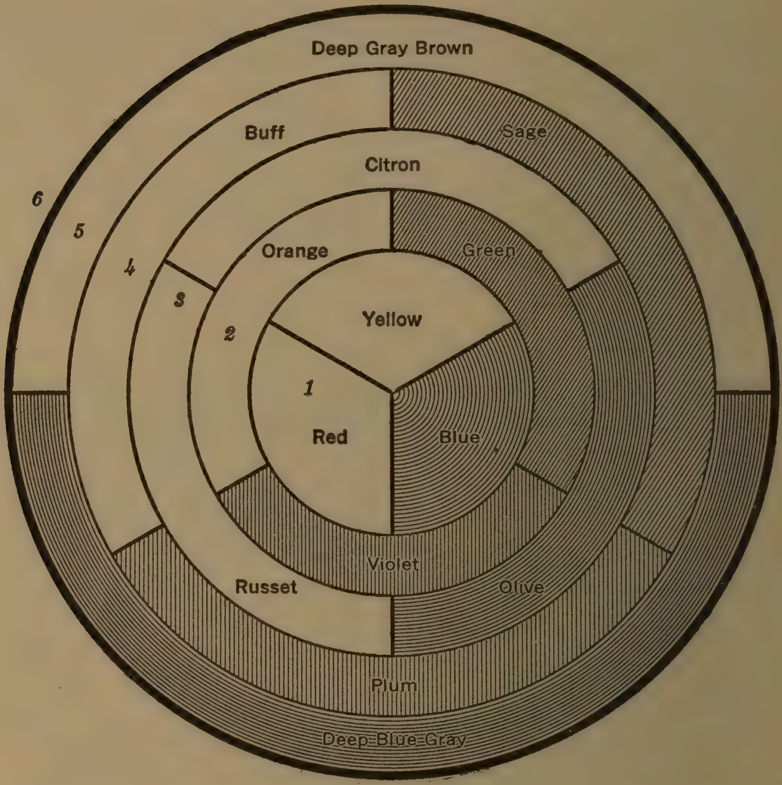
Likewise, imagine the same tube turned bottom up and the same procedure repeated with a *black paint*. As the level of this mixture rises the *shade* approaches closer and closer to the true black represented by the full black plane. The changing mixtures of both the white and the black are indicated visually by the vertical percentage scale, Figure 8.

TERTIARY COLORS, as will be seen by referring to the family tree of color (Table 1), are mixtures of secondary colors. In comparing them with the chromatic circle (Figure 6), many interesting relations will be noted.

POPULAR COLORS, obviously, cannot all be shown here, for there is an infinite number of them. But all colors have a certain relation to the color circle, whether it be a location near its center, on the angle or degree of its diameters, or on an imaginary plane above or below it.

It is the custom of wearing-apparel manufacturers and others to popularize certain shades and tints at certain seasons by assigning popular names to them. For example, Robin's-egg blue is a color that might be designated gray-green-blue-green in the chromatic circle. Obviously, a book such as this could not mention the thousands of shades and tints of spectral colors that have been commercially named.

It is interesting to note, too, that exactly the same variation in color is popularized at different seasons by two or more names. For example, gray-red-orange



1 Primary, *2* Secondary, *3* Tertiary, *4* Quaternary, *5* Deep Gray, *6* Black

Tertiary Colors

	PARTS		
	Yellow	Red	Blue
Olive	1	1	2
Russet	1	2	1
Citron	2	1	1

Quaternary Colors

	PARTS		
	Yellow	Red	Blue
Buff	3	3	2
Sage	3	2	3
Plum	2	3	3

Figure 9.—Tertiary and Quaternary Colors

has been called coral, copper, peach, flesh, terra cotta, crab apple, salmon, natural mahogany, light red, venetian red, garnet, and so forth, at various times and by different commercial agencies and authorities.

QUATERNARY COLORS (Figure 9) are mixtures of the tertiary colors. The wide variation in the number of different colors that may be mixed and still come within the limits of either the tertiary or the quaternary colors is surprising, when one considers that, for example, an olive color is olive until it passes into either the russet or the citron section. Actual samples of the tertiary and quaternary colors are shown in Color Plate VI.

The diagonal lines in the two tables, Figure 9, are merely for the purpose of calling attention to the fact that the two parts used of each of the primary colors seem to have a systematic relation to the colors made from them.

II

COLOR CHOOSING

The Procedure
Legibility
Color Range
Color Blindness
Fading Colors
The Harmony Triangle
The Selection of Colors

Perhaps the most important question relating to color is just how and what color to select. One person may be partial to blue, another to pink, and so on. These facts must be taken into consideration along with those outlined below. However, if colors are chosen by reason, rather than by accident, more pleasing harmony and appearance is sure to result.

THE PROCEDURE suggested below in using the color chart (Color Plate VII) will prove a valuable guide.

First: Select the color with the aid of the language suggestions given on the face of the color choosing chart (Figure 17) and any other information that is closely related to the matter of choice, notably sequence of color combinations.

Second: Turn the *complementary arrow* (Figure 10) to the color selected and note its complement. A *little* of this complementary color may be used in the color scheme finally adopted, such as a flower in a room, et cetera.

Third: Turn the *base color* arrow of the *harmony triangle* (Figure 12) to the color selected and note that the other arrows indicated by the letters *B, C, D, E, F,* and *G* point out six additional colors from which to select the colors desired. *Do not* select colors indicated by the arrows *H, J,* and *K.*

If the six colors indicated in the outer circle do not satisfy, pick out those in the inner circle. This gives a choice of 14 possible colors that may be used together.

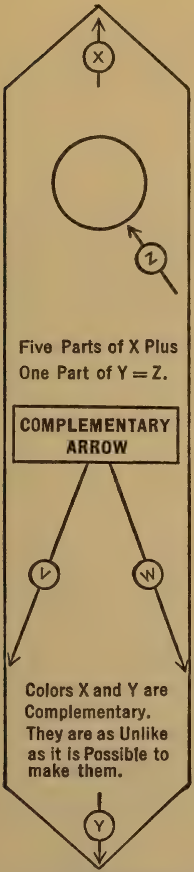


Figure 10.—Complementary Arrow

Legibility is an important factor, for example, in the making of signs. In this connection, the tabulation given in Table 2 will be useful in the selection of colors that can be seen best from a distance. In the rating of these different combinations, the distance from the eye, the size, and the form were the same in each.

TABLE 2

LEGIBILITY OF COLOR COMBINATIONS

(Le Courrier, *Scientific American*)

ORDER OF LEGIBILITY	DECORATION	BACKGROUND
1	Black	Yellow
2	Green	White
3	Red	White
4	Blue	White
5	White	Blue
6	Black	White
7	Yellow	Black
8	White	Red
9	White	Green
10	White	Black
11	Red	Yellow
12	Green	Red
13	Red	Green

COLOR RANGE, or the distance at which different colors may be seen, is a subject of timely interest on account of a difference of opinion in the selection of colors for automobile traffic signals. Therefore, a scientific reference on the effective range of various colored lights is interesting. The distances given in Table 3 were worked out by Paterson and Dudding, in

TABLE 3

EFFECTIVE RANGE OF COLOR

COLOR	MILES
Red	3 —3.5
Green	2.5—3.
White	2 —2.5
Yellow	1 —1.5
Blue	0.5—0.75
Violet	0.5—0.75

a series of careful tests and published in the proceedings of the Physical Society of London.

Red likewise is said to show farthest through dust and smoke, thus making its choice as a danger signal wise.

Color Blindness is a factor to be considered in the choosing of colors. According to Bentley, an eminent psychologist, possibly two male persons in one hundred are color-blind, which means that those persons cannot see a red or a green color. To them, these colors appear gray. In the selection of trainmen, railroads exercise extreme care not to employ anyone who is color-blind to work where the lives of persons are likely to be endangered by their inability to distinguish colors. The fact is mentioned here to call attention to the user of this book that such a condition exists and may be, for example, the basis of a misunderstanding or difference of opinion in regard to the selection of a particular decorative scheme. It is to be noted, also, that there are some persons who are totally blind to all colors and who see nothing but black, gray, and white.

Fading Colors often are a great disappointment. In selecting shades and tints, therefore, care should be taken to avoid those which are fugitive. An article finished in a non-permanent color will, in the course of time, be one shade on the side which has been exposed to the sunlight and another shade on the side farthest removed from the sunlight, as wherever fading occurs the action is apt to be more pronounced in sunlight and less so in the dark. For further information, refer to Chapter XI on Color Testing.

THE HARMONY TRIANGLE aids in choosing colors as well as in mixing and harmonizing.

> THE HARMONY TRIANGLE points out instantly the colors that do not harmonize—arrows *H, J,* and *K,*—as well as those that do. It is evident that a dress made of equal parts of orange and blue would not look right—imagine a person wearing a blue skirt and an orange waist! The harmony triangle tells why they do not harmonize and suggests other colors that do. On the other hand, these same colors on a certain advertising sign might be appropriate, provided some attention were paid to harmony by proportion of area.

THE SELECTION OF COLORS for a reception room, for example, would involve the language or choice of colors. Naturally, a warm color would be selected—but suppose that of the warm colors indicated orange is too bright. No doubt, then, a color near to it in an inner circle, a gray-orange, for instance, would be agreeable. The next question would be to have the woodwork and rug harmonize. If you place the circle Z in the complementary arrow (Figure 10) over the gray-orange color, you will note that the arrows *V* and *W* point out blue-green and blue-violet. Another and obviously better choice of colors would be those located in the inner circles indicated by the divisions in the circular scale (Figure 14), say, within the area *E-F*.

Once the wall finish is agreed upon, the color of the ceiling must be selected. This color should be the same as that of the wall mixed with white or lightened, although it is often customary to make both the walls and the ceiling the same. As for the floor, no mistake will be made if you select the wall color mixed with black—in other words, a dark shade.

The choosing of the finishes for the furniture and other important articles comes next. The harmony triangle (Figure 12) will aid in this selection, provided you are cautious in the use of the colors indicated by the arrows *H, J,* and *K.*

III

COLOR MIXING

The Use of the Mixing Triangle
Tinting Colors
Color Mixing
Groups
Rules for the Mixing of Colors
Colored Baking Enamels

The Use of the Mixing Triangle (Figure 11) will be a revelation to many as soon as its real value is discovered.

Many practical men have used approximate standard manufactured colors because they feared the task of mixing. However, the mixing triangle is so simple that, with a little experience, it will be found to actually save the user many dollars, not only in regular mixing, but in using up left-over materials as well.

The use of the mixing triangle is explained as follows:

When *A, the base color,* points to *orange, green,* or *violet* (it will not work in any other position) theoretically:

1. Three parts of *H* plus 1 part of *B* equal *G* in the outer circle.
2. Three parts of *B* plus 1 part of *H* equal *J* in the outer circle.
3. Equal parts of *H* and *B* equal *A*.
4. Colored pigments *H, B,* and *K* mixed together produce *Gray*.
5. Black and White mixed together produce *Gray*.
6. Any two complementary colors also produce *Gray*.

In mixing colors always add the dark color to the lighter, instead of the reverse.

It is important to note that in mixing colors, one must always use the outer circle or spectrum colors as a basis. The color may be a tint or a shade or a color mixed with some of its complement, but all these characteristics may be determined after the hue is located (Figure 14) at the proper angle.

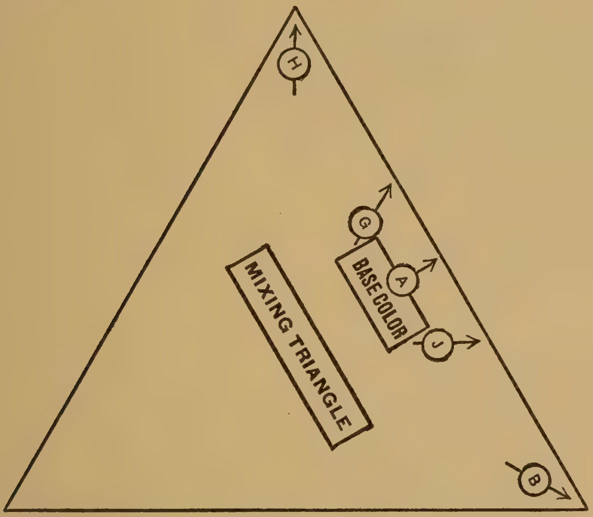


Figure 11.—Mixing Triangle

Tinting Colors used in mixing will be found in the following list and when mixed with white and black will produce a wide variation of colors:

A. Reds
- Vermillion
- Venetian Red
- Burnt Sienna

B. Yellows
- Medium Chrome
- French Ochre
- Raw Sienna

C. Miscellaneous
- Burnt Umber
- Chrome Green
- Black

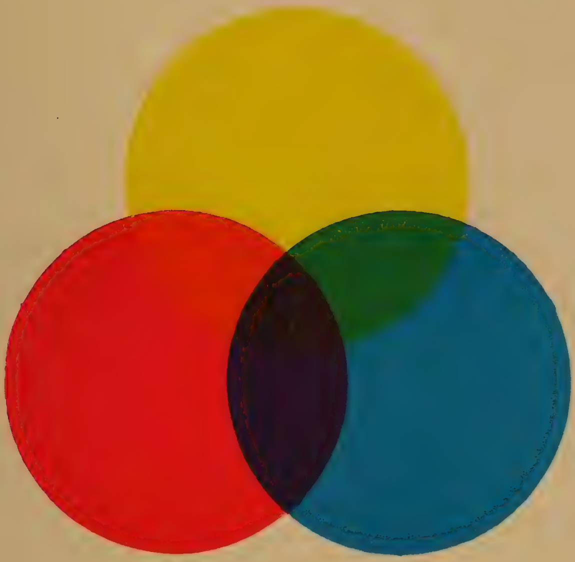
To carry out the following experiments in color mixing the only tools required are a palette knife and a piece of plate glass. Take some of each of the colors—yellow, for example—and see how many shades of yellow can be produced from each by mixing into the white as follows:

Medium chrome yellow, and a little green to cool it.
French yellow ochre, and a little burnt sienna to warm it.
Raw sienna, and a little burnt umber to neutralize it.

COLOR MIXING may be carried on without end. For example, a pleasing orange may be made by mixing about four parts of yellow to one part of red; green by mixing yellow and blue, four to one; and violet from the mixture of red and blue. Reference to Color Plate I will help.

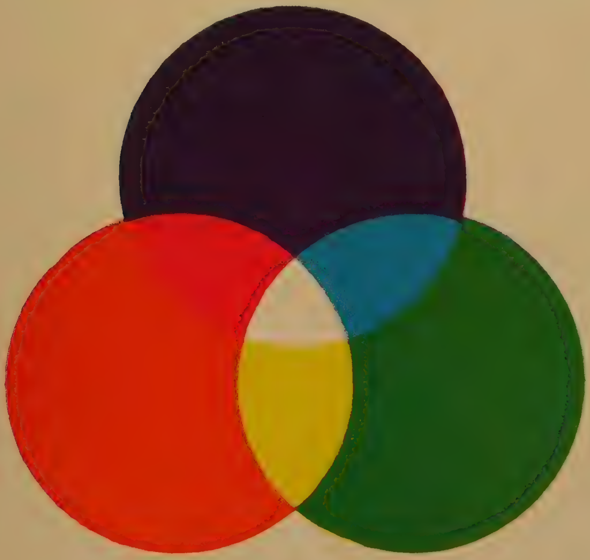
To secure the tertiary colors (Table 1, and Figure 9) all that is necessary is to mix four parts of orange and one part of green to make citron; four parts of orange and one part of violet to make russet; and four parts of green and one part of violet to make olive. With these nine colors, together with black, white, gray, silver, and gold, the reader will find he has all the colors entering into everyday use.

Both the secondary and the tertiary colors are easy to control. If in mixing the four parts of yellow and one part of red the resulting orange is too dark, it may be made lighter by adding a small quantity of yellow; or, if a more reddish orange is desired, simply by adding more red. The same rule applies to secure the desired green; by adding more blue a deeper, bluer



PART 1

Subtractive or *Pigment* Color Mixture



PART 2

Additive or *Light* Color Mixture

Color Plate I.—PIGMENT AND LIGHT COLOR MIXTURES

green is secured; or a violet on the reddish shade may be had by adding more red.

GROUPS of colors (Table 4) may be combined to produce certain predetermined results. Here are given some simple mixtures for those who do not care to go into the matter of color mixing deeply.

TABLE 4
COLOR GROUPING

THE FOLLOWING GROUPS MIXED TOGETHER	MAKE
Black and Red	Brown
Black and Venetian Red	Chocolate
Blue, Red, and White	Lavender
Blue and Lead Color	Pearl
Blue and Yellow	Green
Green and Yellow	Pea Green
Indigo and Lamp Black	Silver Gray
White, Vermillion, and Carmine	Pink
White, Yellow, and a little Vermillion	Cream Color
White and Lamp Black	Lead Color
White and Red	Brown
White and Yellow	Straw Color

RULES FOR THE MIXING OF COLORS are important. Some of them are:

1. Remember that brightness or value, which is the position a certain color holds between the extremes, dark and light, is important.
2. Light and cool colors make things look larger.
3. Dark and warm colors make things look smaller.
4. Knowledge of colors and shades to guide and help a customer will make him a life-long friend. It pays to work out special exclusive shades for customers and advise others to adopt an-

TABLE 5
COLORED BAKING ENAMELS

NAME	TO HARDEN		MIXTURES			
	BAKE FOR HOURS	AT DEGREES F	OUNCES	PIGMENT	QUANTITY	VEHICLE
Royal Blue	4	100	4	Blue	6 Ounces	Finishing varnish
			1	Red		
Ultramarine	1	125	64	Ultramarine Blue	1 Quart	Rubbing varnish
Chrome Green Light	1	125	1	Chrome Green Light	3 Ounces	Finishing varnish
Red Brown	1	125	8	White Enamel		
			20	Venetian Red (ground in gold size)		
			16	Burnt Umber (ground in gold size)	1½ Pints	Baking varnish
Vermillion	4	100	1	Vermillion	3 Ounces	Finishing varnish
Imitation Mahogany	4	100	1	Burnt Sienna		
			2	Chrome Yellow Deep		
Maroon	4	100	1	Maroon Red	4 Ounces	Finishing varnish

other color that would better fit into the environment of their product.

5. Always stir in the lighter color first in making compound colors. They are more delicate and lose their identity if added later.
6. The secondary colors add the greatest contrast for their corresponding primary colors.
7. Contrasts are less pronounced with warm colors than with a warm and a cool color.
8. Shades and tints of the same color go well together.
9. On a certain color-card maker's shelves, there are 664 different shades of green! What more does one want to prove the fallacy of attempting to match a certain shade of green? Then too, there are the effects of light and heat as well as the element of time to complicate the problem.
10. Remember that baked colors cannot be mixed to match air-dry colors. One may get close but for most purposes a *contrast* in color would be much better than a poor match.
11. Suppose the user had some surplus *yellow* to dispose of. He sets the color triangle at *yellow* and finds that he may either add some *blue* to make *green,* or he may add some *red* to make *orange.*
12. The color in mind may be a special shade. The color triangle will show at once the two colors that are needed to obtain the nearest color shown in the circle and then it is a matter of trying out those two colors to arrive at the special shade. It may be necessary to mix in some white, black, or gray.
13. Gray is a mixture of white and black, or of any two complementary colors, such as yellow and violet. Another method of mixing is given on the complementary arrow.

    The primary triangle with *yellow* at the top and *red* and *blue* at the base is the source of all color harmony and all color mixing.
14. This mixing information is applicable to all aniline and pigment colors, such as paints, varnishes, lacquers, inks, dyes, and so forth, but with light mixtures there are certain exceptions.

Colored Baking Enamels were valuable when it was customary for users to do their own mixing, but the manufacturing of enamel has progressed so rapidly in the last few years that it is now a highly specialized industry. A user would be shortsighted indeed who would now attempt to mix by hand quantities of his own paints and enamels when the manufacturer uses highly specialized machinery. There are times, however, when it becomes necessary to do so, and Table 5 is inserted here for the benefit of those who want to know what was used by some of the old-time finishers.

IV

COLOR HARMONY

Harmony
Associated Combinations
The Basic Facts
The Kinds of Harmony
A Harmony Table
The Sequence of Color Combinations
Three-Color Combinations
Proportion
Names of Harmonious Combinations

Harmony of colors exists only when there is a common color present. For instance, orange and green harmonize with each other because yellow enters into the making of both. Since blue enters into the making of both green and violet these three colors harmonize. Equal parts of red entering into the making of orange and violet makes a harmony of these three. Olive and citron form a harmony because green enters into both. But since blue does not enter into the composition of orange, which is made of yellow and red, it becomes the contrasting color of orange. Red is the contrasting color of green, because green is made of blue and yellow and contains no red. Also, violet becomes the contrast of yellow since no yellow enters into its composition, violet being made of red and blue.

Associated Combinations of harmonious colors are pleasing and restful and are used more than any of the others. Certainly they are the best on surfaces that are to be seen for long periods, such as living-room walls.

THE BASIC FACTS covering the harmony of colors are few and very simple. They are as follows:

> The addition of a little gray to any two colors makes those two colors harmonize.
>
> A harmony may also be accomplished by adding either a little black or a little white instead of gray. (Black may be mixed with one and white with the other.)
>
> Any two colors may be made to harmonize by mixing a little of one into the other.
>
> The presence of a common color in any two colors makes them harmonize.

Best results are secured in contrasts by using a small proportion of the dominant color in two-color contrast. Red, being a primary color and stronger than green, should be used more sparingly than green when both colors are contrasted. Likewise, yellow, being stronger than violet, should cover a smaller surface than the latter. This also applies to blue when used as a contrast to orange. A few two- and three-color harmonies that may be safely used, if a little of one is added to the other, are yellow and violet; orange and blue; red and green; orange and violet; light blue and deep red; yellow and blue; dark and light blue; violet and green; russet and orange; olive and yellow; green and russet; black, orange, and light blue; gold, red, and blue; orange, green, and light blue.

THE KINDS OF HARMONY generally used are divided into four classes:

> A *one-color harmony* is shown on the complementary arrow (Figure 10) as *X* and *Z*.
>
> An *associated harmony* is shown on the harmony triangle (Figure 12) as *C* and *D*.

A *true complementary harmony* is shown on the complementary arrow (Figure 10) as *Y* and *Z* and a *split harmony* as *V* and *W*.

The same rules hold true of all tints and shades of the particular colors involved.

A HARMONY TABLE (Table 6) is included to help the reader who does not choose to use the harmony triangle. It contains a limited list of popular colors.

TABLE 6

HARMONY TABLE

COLOR	HARMONIZES WITH
Brown	Orange, Cardinal
Brown	Turquoise, Mauve, Gray
Cardinal	Turquoise, Marine Blue
Crimson	Green
Garnet	Sapphire, Mauve, Pearl
Gray	Violet, Crimson, Lavender
Heliotrope	Cream
Lavender	Green
Mauve	Emerald, Dark Brown, Garnet
Orange	Violet, Light Blue, Indigo
Old Rose	Any shade of Blue
Pink	Light Blue
Purple	Orange
Red	Blue, Gray, Green
Rose	Light Blue
Scarlet	Ecru, Light Blue
Violet	Light Green, Dark Green
Yellow	Violet, Blue, Green

THE SEQUENCE OF COLOR COMBINATIONS becomes quite important in the decorations of homes and offices. When one stands in the hall of a home, for example, and looks through one or more rooms, he should not observe any color discords. Some home decorators, in order to guard against this, confine the colors used in decorating the walls of different rooms to very few hues, or have adjoining rooms of the same color; yet, with a fair knowledge of color, the most pleasing and beautiful combinations imaginable may be used. There is nothing really difficult about selecting combinations with the aid of the harmony triangle (Figure 12) and the chromatic circle (Figure 6).

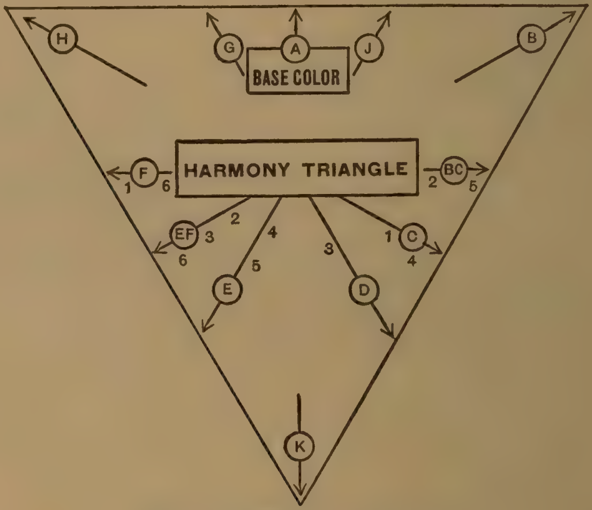


Figure 12.—Harmony Triangle

Assume that a start is made in the entrance hall of a home, say, with a subdued tint of green for the walls, it would then be agreeable to use a light yellow for the ceiling and a blue rug for the floor. The room adjoining the hall should tie in harmoniously with the colors used in the hall, and the proper combination to use would be designated by moving arrow *A* of the harmony triangle two steps, or 60 degrees, in a clockwise direction from green to blue.

This would suggest a blue wall, a blue-green ceiling, and a violet floor covering. Moving arrow *A* again to violet would suggest a blue ceiling, a violet wall, and a red floor or floor covering for the next room, and so on around the circle. Of course, the spectral colors would not be used, but shades and tints of them would, and the net result would be a very pleasing intercombination of colors worked out on what I call the diagonal theory (Figure 13). Here the walls of one room agree with the ceiling of one adjoining room and with the floor of the other adjoining room.

THREE-COLOR COMBINATIONS may be selected at will by using the numbers on the harmony triangle (Figure 12).

> To select a three-color harmony, point Arrow *A* to the base color desired. The other two colors may be chosen by using the small numbers on the harmony triangle. For example, *A, E,* and *BC* form three-color harmony Number 5.
>
> It should be noted that any shade or tint of any of the colors indicated by any of the arrows will fit into that particular harmony, provided the colors selected lie in the *radius* indicated by the arrows. Adding black, white, or gray to them *does not* disturb the harmony, but good judgment in the use of these in balancing the colors involved improves the selection.

PROPORTION covers a point that many users of color overlook. This is best explained by selecting a pair of

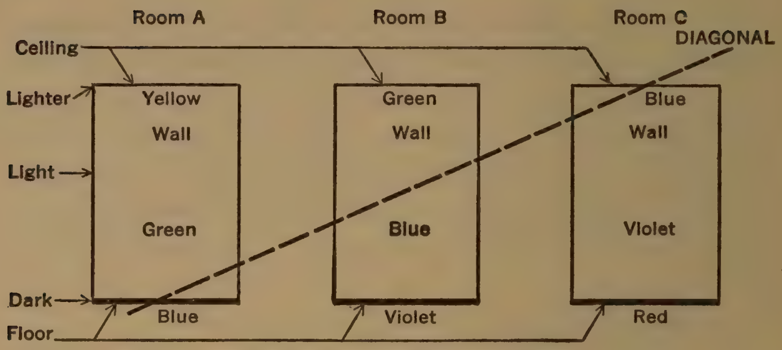


Figure 13.—THE DIAGONAL THEORY

complementary colors as designated by the complementary arrow (Figure 10), say red and green. As stated elsewhere, colors at the two ends of this arrow are as unlike each other as it is possible to make them. This means that they do not harmonize. However, it is possible to use even these two spectrum colors together if the areas covered are in proportion to the intensity of the colors, but this relationship can be ascertained only by test and study.

Such a test might be made as follows: First, paint a spot, say, 6 inches square in green, the lighter of the two colors. Next paint a much smaller area, perhaps not over 2 inches square, beside it in the red or darker color. Increase the size of the latter area until it is certain that the two colors do not look well together and then start increasing the green until they do. After it is felt that a harmony exists, figure out the square inches of surface covered by each and use their proportion as the proportional surface of each color that should be used in decorating the wall or whatever the surface may be. For example, if there were 36 square inches of green in the painted area and 4 square inches of red, then it would be necessary to use 9 times as much green as red.

Finally, as a check upon the harmony of the proportions of color determined as above, mix a little of the paint in these proportions together and if the result is gray, then the choice of colors is sure to be correct. However, on account of the varying strength of colors, this does not always prove out.

Mixing both of the colors with white might produce a more appropriate effect, and the result would be a lighter gray in the test proof just mentioned.

NAMES OF HARMONIOUS COMBINATIONS of colors are coming into use more and more. In the automobile industry, for example, such names as Grand Canyon, Orchid, Cigarette, immediately make one think not of any one color, but of several.

In the textile industry, such dress goods combinations as Rainy Day, Ticker Tape, and the like, combine *action* and color in a title that is very descriptive indeed.

V

COLOR MATCHING

MATCHING	USE OF THE COMPLEMENTARY COLOR
THE CIRCULAR SCALE	USING THE COMPLEMENTARY ARROW

MATCHING has been more or less evaded by most practical colorists in the past, possibly for fear of the seeming complications that existed. However, the demand on the part of the public for service is fast changing old customs, for the good of all concerned—of the practical painter, who realizes that a little color knowledge is very helpful, and of the manufacturer of paints, because he is not forced to run or mix small batches of material at a loss in order to fill small orders.

And, really, color matching is so simple that one wonders why he did not learn how to do it long before. First, it must be realized that all colors, shades, and tints have a location somewhere within the chromatic cylinder (Figure 8) and that the addition of black, white, or gray (which is a mixture of black and white) does not affect this location as regards the radial plane of the chromatic cylinder upon which the particular color in question may be located.

THE CIRCULAR SCALE is simply a measure around the circumference of the chromatic circle. It is used to locate the hue. Imagine the chromatic circle to be divided into 360 degrees, according to the *circular scale*

(Figure 14), in a clockwise direction with zero and 360 degrees coincident with the vertical radius passing through yellow at the top. Yellow-green will then be 30 degrees, green 60 degrees, blue-green 90 degrees, and so on around the circle.

Now, given a certain sample to be matched, it may

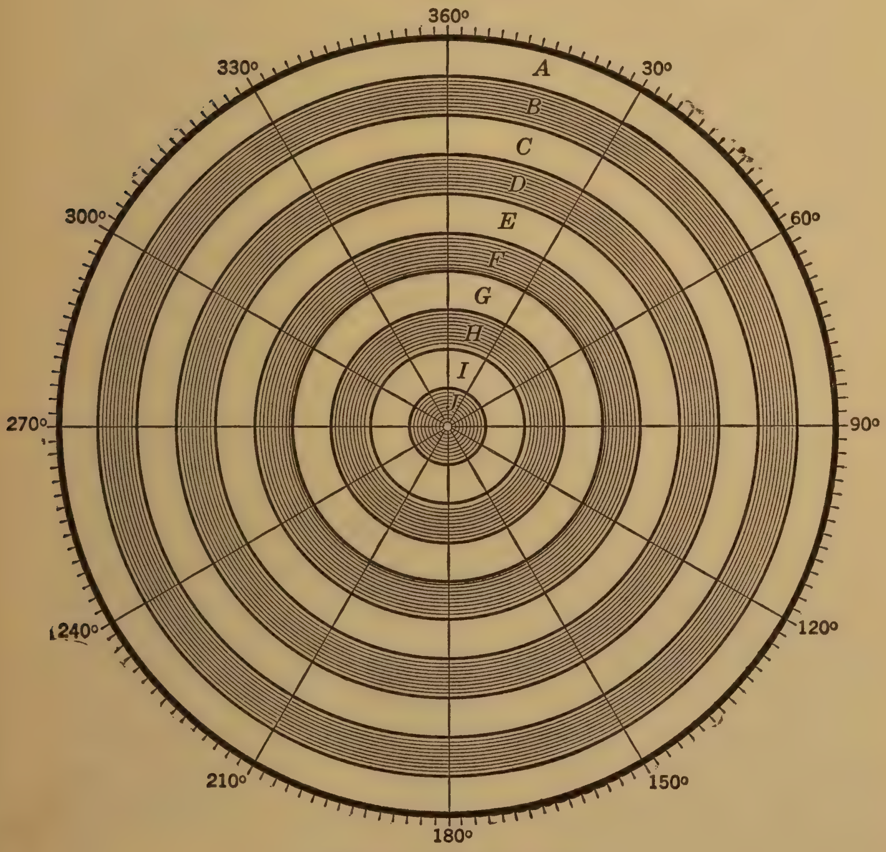


Figure 14.—Circular Scale

be assumed to be located on the 48 degree radius and that it is a shade which indicates that black has been used in its make-up. The first move is to place the mixing triangle (Figure 11) on the chromatic circle (Figure 6) with base arrow *A* pointing toward green, the general color that we know is to be matched. By consulting the directions herein, and mixing a certain amount of color indicated by arrow *H* and a certain amount indicated by arrow *B,* you will have a green.

Theoretically, half yellow and half blue will make the green shown in the outer circle on the 60 degree radius. Thus, with this green already mixed, all that one need do to mix the particular green that lies in the 48 degree radius is to add a little more yellow. By experimenting with small samples of material on a piece of glass, one may arrive at the right color first, *before getting too large a quantity in process,* and then mix the larger amount of material. Were I to caution a practical painter on proper procedure it would be to bring this point to his attention most emphatically, because many painters in mixing colors make just this mistake.

The color in question on the 48 degree radius is now mixed and available and all that is necessary is to add a little black to shade it and bring it close to the sample that we are trying to match. Thus it will be seen that we attack the matching problem in a round about way; first by establishing the location of the color in the outer circle and then tinting or shading it with white or black so as to locate it in another plane.

USE OF COMPLEMENTARY COLOR, red, for example, to alter the hue of a color obtained by mixing certain portions of yellow and blue together to make green, is the next important step in color matching. Thus, we are brought face to face with the mixing, not of two colors, like blue and yellow, but of three colors—yellow, blue, and red.

USING THE COMPLEMENTARY ARROW (Figure 10) in conjunction with the mixing triangle, therefore, you will be able to arrive at the composition of almost any color sample with little difficulty. This is particularly impressed upon one who has had the interesting experience of attempting to use up an accumulation of odds and ends in paint and lacquer colors that have been cast aside from day to day with the good intention of sometime using them individually.

A wonderful aid in a situation of this kind is a full-sized set of the various color circles and devices mentioned above aided by a color deck of 77 colors, which includes a set of 5 standard color chips corresponding to each of the 12 colors in the chromatic circle (Figure 9), one light and one lighter made by mixing a little white with the color and one dark and one darker made by mixing a little black with the color. These sets of 5 colors aid one in selecting a one-color harmony, such as described in Chapter IV.

VI

COLORED LIGHTING

Pigment and Light Color Mixtures
What Red to Choose as a Basis
Colors That Signify Certain Holidays
The Color Art of the Future
Colored Lighting in Show Windows
Colored Light in the Theater
Colored Light in the Home
Colored Lighting of Exteriors
Colored Light and Music
Mercury Arc Lamps
Clear Lacquer

Caution: Do not confuse the information in this chapter with that in other chapters dealing with pigments. There are marked differences.

It should be stated at the outset that the theories underlying the mixing of lights and the mixing of pigments are entirely different. Further, a clearcut knowledge of just what the differences are is necessary in order to avoid confusion on the principal subject matter of this book.

Pigment and Light Color Mixtures are very instructive and enlightening, as will be seen by a study of Color Plate I, Part 1, which is an illustration of the *subtractive or pigment method,* the foundation upon which all the color theory in this book is based; while Part 2 shows the effects which result when the combinations are made by the *additive or light mixture* method.

These light mixtures agree with those obtained when use is made of the mixing triangle (Figure 11) in dealing with pigments. Also, it should be especially noted that the mixing triangle functions, in the case of pigments, *only* when the base arrow points to one of the *secondary* colors and that in the case of light mixtures there is no such limitation placed upon it, which means the mixing triangle is applicable throughout the circumference of the chromatic circle. In other words, whenever arrows *H* and *B* point out a pair of colors, the resulting light mixture of them will be indicated by base arrow *A*.

Again, it is interesting to note that the opposite end of the complementary arrow (Figure 10) points out the colors of the additive mixtures, Color Plate VI, Part 2, when the one end is directed to any of the colors of the primary triangle (Figure 5).

Since there may be some doubt about the manner of making Color Plate I, let me say that it was done by the three-color process with solid faced cuts. Thus, we have an *actual* example of the colors resulting when printing ink of one color is used over that of another color.

The great differences in the strength of colored pigments used in connection with the mixture of, say, yellow and red pigments, using the mixing triangle (Figure 11), superimposed upon the chromatic circle (Figure 6), gives one a wide variation of hues as indicated by the other arrows on the triangle pointing to the intermediate colors. Again, much depends upon what one selects as the basic red to mix with the yellow. There is a tendency for many color authorities to choose as *red* a color that would be closer to violet than the one I have chosen.

WHAT RED TO CHOOSE AS A BASIS in the chromatic circle is the cause of much disagreement among color authorities. This indirectly, of course, makes the shade of orange also questionable, since a red-orange may easily be taken for either red or orange, depending upon its location in the circular scale (Figure 14). I choose to call *orange* the color that results when yellow and red are mixed (Color Plate I, Part 1). When orange and violet are mixed the color that results is *red*. (Color Plate I, Part 2.)

COLORS THAT SIGNIFY CERTAIN HOLIDAYS or seasons are not to be overlooked. Yellow is used to denote spring; red, Christmas and St. Valentine's day; green, St. Patrick's day; amber, Thanksgiving day.

THE COLOR ART OF THE FUTURE has been ably indicated by Charles Bittinger, artist, of Dubury, Massachusetts. A few years ago he displayed publicly some paintings which were novel indeed. Under daylight or ordinary electric light a portrait of a beautiful girl appeared, while under a red light, thrown on the picture, the same canvas showed a picture of a soldier on a horse.

This is accomplished by means of the invisible spectral difference of pigments—that is, two colors which look exactly alike under daylight but may be changed in color and brilliancy under another light. This fact opens a new field for artists in work for the stage, advertising, and interior decoration. It is also possible to make the pictorial change without any apparent change in the light, this being done by using an invisible spectral difference in the two lights which illuminate the picture.

The combination under Charles Bittinger's system makes the scope of color almost unlimited. This means that artists of the future will have to be educated in physics and science as well as in art.

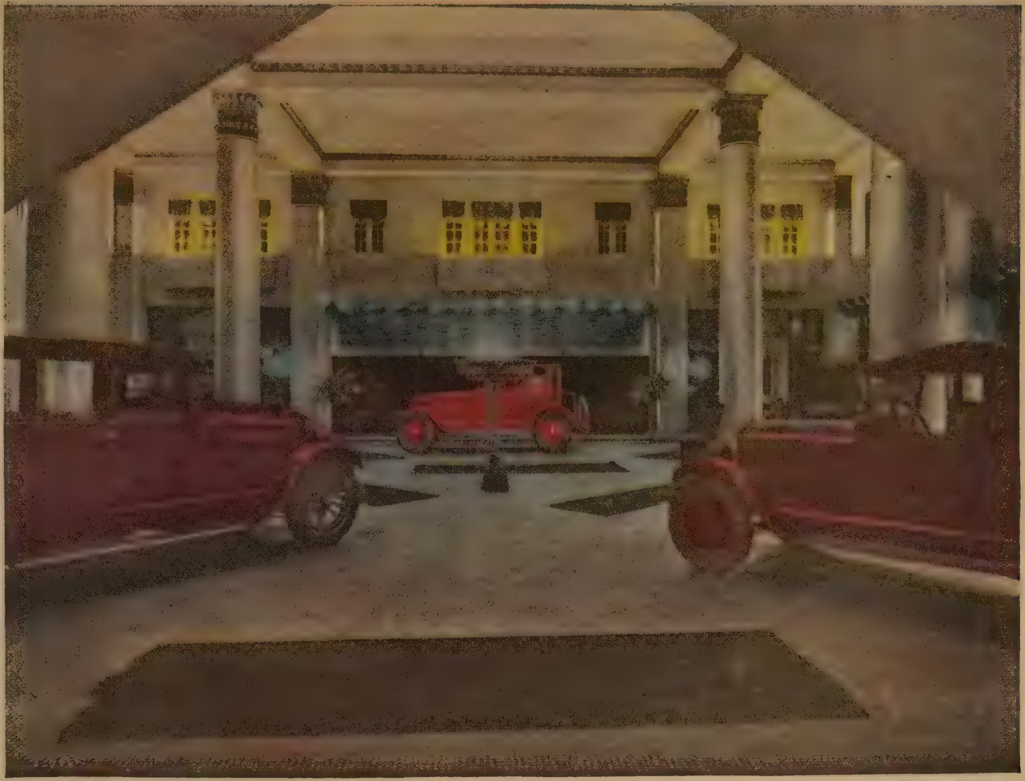
COLORED LIGHTING IN SHOW WINDOWS (Color Plate II) is a most popular application of this aid to beauty in producing attractive and pleasing window displays. Indeed, the merchant who does not consider this feature nowadays is not in step with the modern trend and is sure to be losing business to those who are giving it the thought it deserves. Really, nothing but a little knowledge of what effects may be brought out by using colored lights is needed.

A study covering the apparent color of objects or surfaces as displayed under certain colors of light is given in Table 7 and will be found most valuable. Among other things, it will be noted that some colors of light and colors of objects are almost neutralized when *those* certain colors pointed out by the complementary arrow are combined. The table shows this in still another interesting way by a *diagonal* arrangement.

Light of one color falling on an object of the same

TABLE 7
APPARENT EFFECTS OF COLORED LIGHTING

COLOR OF OBJECT	COLOR OF LIGHT							
	White		*Yellow*	*Orange*	*Red*	*Violet*	*Blue*	*Green*
White	White		Yellow	Orange	Red	Violet	Blue	Green
Yellow	Yellow		DARKER YELLOW	Yellow Orange	Orange	*Very Dark*	Dark Green	Yellow Green
Orange	Orange		Yellow Orange	DARKER ORANGE	Red Orange	Dark Red	*Very Dark*	Dark Yellow
Red	Red		Orange	Red Orange	DARKER RED	Red Violet	Violet	*Very Dark*
Violet	Violet		*Very Dark*	Dark Red	Red Violet	DARKER VIOLET	Blue Violet	Blue
Blue	Blue		Dark Green	*Very Dark*	Violet	Blue Violet	DARKER BLUE	Blue Green
Green	Green		Yellow Green	Dark Yellow	*Very Dark*	Blue	Blue Green	DARKER GREEN
Black	Black		Olive	Dark Red	Red Violet	Dark Violet	Dark Blue	Dark Green



Color Plate II.—An Artificially Lighted Automobile Salesroom

color merely darkens that color. With these exceptions the harmony triangle may be used to anticipate what the apparent color effect will be by referring to the chapter on Color Mixing and considering that when an object of a certain color is to be lighted with another color, there is in effect a mixture of the two colors, the apparent color being the resultant mixture.

Of course, these remarks apply to all lighting and are not confined to show windows alone. Color effects in an artificially lighted automobile salesroom are shown in Color Plate II.

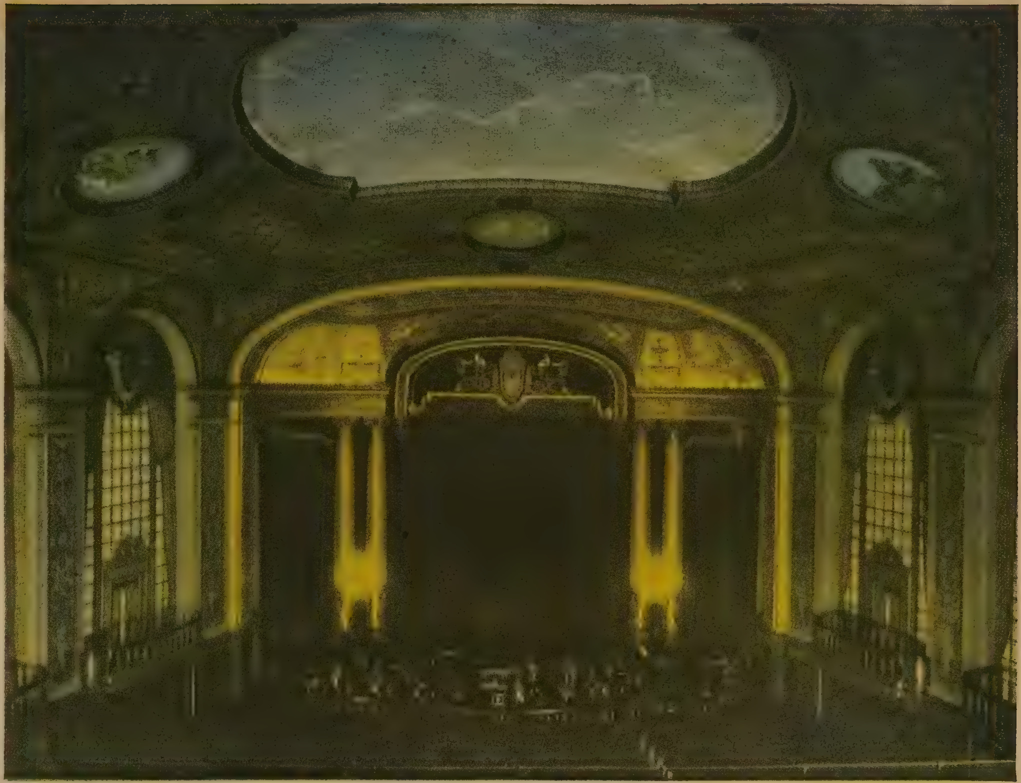
The use of a yellow free from red has resulted in the popularizing of a yellow-green color called amber which has been standardized as one of the screens for use in window lighting. The variations in the coloring material, thickness of the gelatine or glass that is used, as well as variables introduced in the lights themselves make any positive statement as to what the resultant color will be almost impossible.

This means that the only sure way, when one desires to be particular on certain tints, is to experiment with the lights themselves.

COLORED LIGHT IN THE THEATER (Color Plate III) has become one of the most important factors in modern living, and the decorator who has ignored this fact and has proceeded to coat the walls and ceiling with, say, a flat blue shade has made it almost impossible to light up the theater when the curtain is down, as is customary between the acts. Here, the blue interior would interfere with the attempt of the lighting operator to produce a red, orange, or yellow effect throughout the house. On the other hand, were a light yellow paint used (Figure 15 and Color Plate III) in the decoration, these colors could be created without any difficulty.

Modern improvements in the lighting of the stage itself in which advantage is taken of electrical regulation in the circuit to dim or decrease the luminosity enforced by the idea of using various types of color screens make it possible to obtain almost any lighting effect imaginable. The lights for this purpose are assembled in banks containing multiples of, say, three. For example, suppose we have a bank of 9 lights with lights 1, 4, and 7 on one circuit; lights 2, 5, and 8 on another, and lights 3, 6, and 9 on the remaining circuit. Now, over the first set might be placed a yellow-green gelatine or glass color plate mounted in a rectangular frame and designed for easy insertion in a suitable sliding channel; over the second set might be placed blue-violet color frames and over the third set red-orange color frames. Then, by lighting only three lights of the desired set at a time each one of the colors mentioned would be produced. By lighting both the yellow-green and the blue-violet, a blue-green effect would result. Also, it would be possible to make all of the frames alike and thus produce an intensified flood of light in that one color.

All this is further aided by the use of scientifically designed individual silver-mirrored reflectors which



Color Plate III.—A MODERN THEATER

give a very high degree of intensity, agreeable distribution, and very low current cost.

Colored Light in the Home has many unsolved possibilities, and the reader who wishes to familiarize himself with some of them may do so by simply changing a few of the white bulbs in the living room to some colored bulbs. It is not possible to lay down any rules to govern the change. Each individual must experiment for himself.

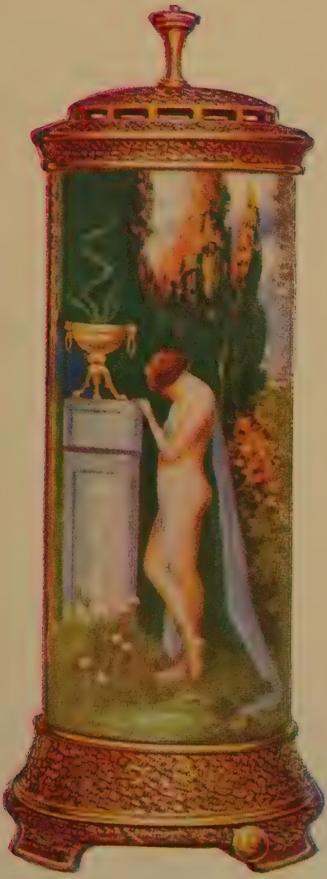
Most every one would desire to combine beauty and utility in the living room, and this would direct us not to use a colored light or screen that would darken the room too much. Perhaps one of the greatest attractions that colored lighting has in the home is in the variations that may be gotten from time to time. When one tires of the wall finish as shown by the white light, a change to a colored bulb will create an entirely different appearance in the room and will serve as a pleasing change for a time at least.

For the hall, boudoir, dining room, and living room there are now available many beautiful designs of perfume lights (Color Plate IV), as well as other beautifully colored toilet necessities that have a place in the home. The increasing popularity of lacquer as a finish has increased the demand for color decoration because of the ease in obtaining colors, and it is most interesting to note that such novelties as perfume lights, so named because they include a means for volatizing perfume through the warmth of the small electric bulb used, are made available. Thus, their use is extending a field that heretofore has been confined almost exclusively to electrical building fixtures. The careful decoration of a room in proper harmony needs something for an accent and something of this kind, rich in quality and design, is very appropriate, not only for the boudoir but for other rooms as well.

Colored Lighting of Exteriors seemingly is of importance today, and the future is likely to make it even more so. Flood lights are being used to play up tall buildings, towers, and monuments. It would seem that an architect who neglects to consider the future possibilities of colored flood lighting for advertising and other display purposes is overlooking an important item in his design or plans.

Perhaps the most recent example of what may be accomplished by colored flood-lighting is seen in the Buckingham Memorial Fountain, Grant Park, Chicago. Here the full colors with the tints and the blends of all of them are sufficient to excite the admiration of all who have the opportunity to view it.

This fountain will become more and more popular as time goes on, and it will be well that those interested in color learn a little regarding it. Its lighting system is of the concealed, indirect type. The lights are equipped with dimmers, which permit the varying of the intensity of the lights and the blending of the colors. Many months of experimenting were required before the electric illumination—30,000,000 candle power—



Color Plate IV.—A Perfume Light

was pronounced a success. With the pumps supplying a maximum of 14,000 gallons of water per minute, and the jets varying from 5 to 110 feet in height during a major display, it is not surprising that the beauty of the famous fountain of Latona in the garden of Versailles has been surpassed by a master four times its size.

Due to the educational value of the Buckingham Fountain, many of the persons who will see it are certain to become unconsciously better acquainted with color. They in turn will demand harmonious combinations in everything that they purchase, whether it be clothing, houses, automobiles, or furniture.

COLORED LIGHT AND MUSIC have been associated together on a very extensive scale only in some of the larger theatrical productions, but I see no reason why this idea cannot be extended to the home as well. Certainly the time is not very far off when, in addition to hearing the notes and sounds coming from the piano, the violin, or an orchestra over the radio, we may be further inspired by an appropriate, silent, effective color lighting accompaniment. When that time comes, the matter of the careful selection of colors for the walls and ceiling will be of prime importance—and that, by the way, is the real reason for introducing this matter on colored lighting at this time.

Some have asked if a color score can be written to accompany a musical story. The answer to this is, not note by note, but an accompanying color effect of some kind is sure to be evolved that will serve the same purpose. This assertion is substantiated by the fact that, in conversing, we do not talk in letters of the alphabet but rather in words which are combinations of letters and in phrases composed of words.

Incidentally, color is more flexible than music, for it can be made to cover not only the intervals, but the space between the *intervals,* while music is limited to the *intervals* only or the mechanical steps, such as the keys on a piano, there being nothing in between them to indicate sounds. In other words, there is a smooth, continuous flow in color and an interrupted one in music.

MERCURY ARC LAMPS, on account of the increasing interest in them, should not be passed unnoticed in this chapter. They have been popularly known as mercury vapor lights and are also classed as ultra-violet radiation units. These lamps have the characteristic of not casting shadows, and for this reason are well adapted to factory lighting.

The ghastly appearance that various colors take on under exposure to ultra-violet radiation has caused many to wonder about its color and characteristics. For the information of the reader the apparent color of the various colors under the mercury arc light is given in Table 8.

It will be noticed that there is a complete absence of red. The light itself is considered to be of a yellow-green color, although the tubular glass when lighted has a bluish appearance. It is interesting to note that

TABLE 8

APPARENT COLOR UNDER THE MERCURY ARC

COLOR	APPARENT COLOR
Blue	Violet
Blue-Green	Dark Green
Blue-Violet	Dark Violet
Green	Light Green
Orange	Darker Yellow
Red	Black
Red-Orange	Darker Red
Red-Violet	Dark Violet
Violet	Dark Violet
Yellow	Yellow
Yellow-Green	Light Yellow-Green
Yellow-Orange	Dark Yellow

the three colors at the bottom of the chromatic circle all appear to be the same color—a dark violet.

CLEAR LACQUER, that is, lacquer without any pigment in it, it should be mentioned here, deteriorates very rapidly when acted upon by ultra-violet rays. This has been demonstrated so strongly that only lacquer containing pigment that will make it opaque can stand up outdoors. However, clear lacquer will stand up indoors because ordinary window glass protects it from the ultra-violet rays of the sun just the same as the glass tube does in the mercury arc lamp. All of which goes to prove that the use of clear lacquer as an interior finish has a future that will be far-reaching indeed.

VII

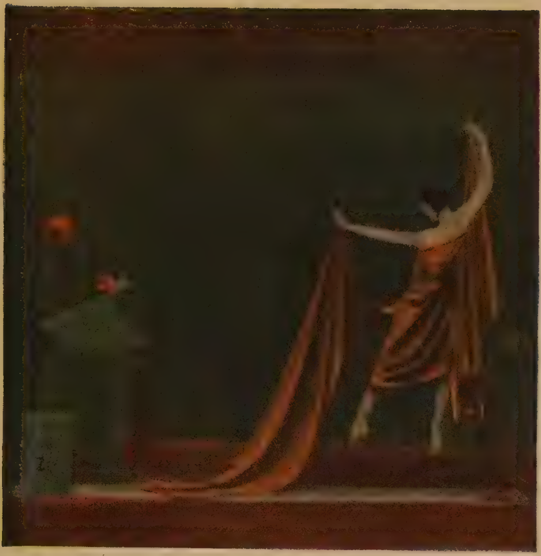
COLOR PHOTOGRAPHY

THE PHOTOGRAPHY OF COLORS — THE EYE OF THE CAMERA
PHOTOGRAPHIC EFFECTS OF COLOR TREATMENT — AMATEUR PHOTOGRAPHERS
COLORS THAT DO NOT PHOTOGRAPH WELL

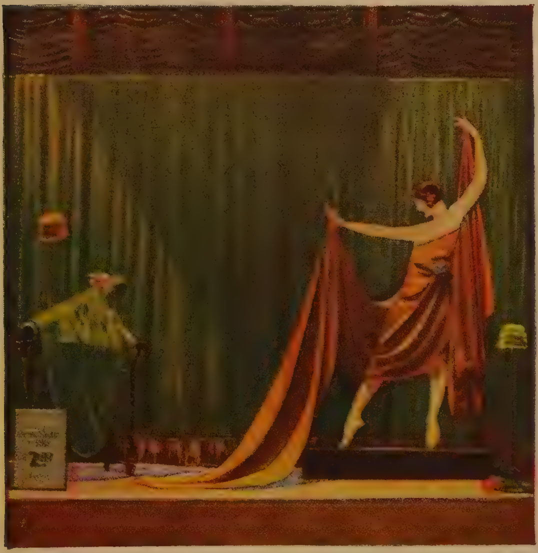
THE PHOTOGRAPHY OF COLORS is a topic that is fast becoming of importance because of the general growing interest in color, and as a consequence both amateur and commercial photographers will no doubt desire to learn more of the color make-up of subjects they photograph.

There is a large and well-established sales method in use today in which good photographs form an important part. As an example, suppose a manufacturer wishes to present his line of window-display fixtures to prospective customers. An ordinary photograph would not do the line justice, but the proper selection of colors for the background, aided perhaps by properly colored lighting, would make it possible to depart from the usual custom of showing just an illustration of the article itself and show, instead, the article or a number of articles in use.

PHOTOGRAPHIC EFFECTS OF COLOR TREATMENT. Color Plate V illustrates two effects of color, one before and one after proper treatment. These prove that it is profitable to devote more attention to effective window



Before



After

Color Plate V.—Photographic Effect of Color Treatment

displays than is ordinarily thought necessary. It is well to know that a means exists through which one may increase the effectiveness of any window display with practically no additional investment other than closer attention to the colors involved in the lighting and in the background, not forgetting, of course, to give attention to the objects that are to be displayed.

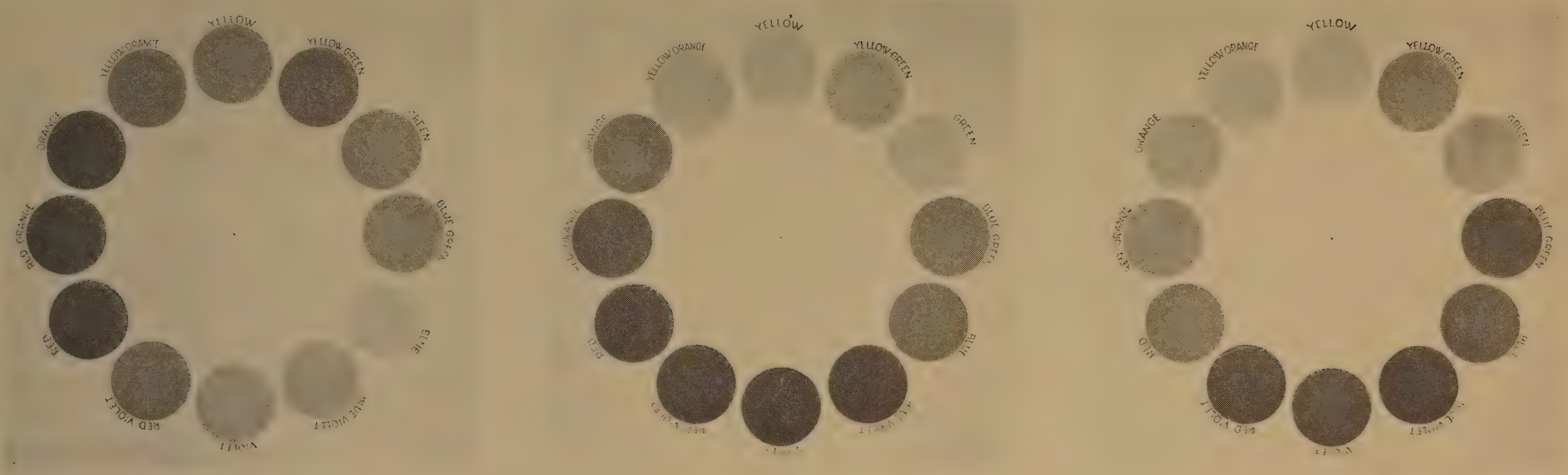
THE EYE OF THE CAMERA, is an expression we have often heard, and it is a strange fact that this so-called "eye" is very searching indeed, for it sees much more than the human eye. By referring to the diagrams (Figures 3 and 4) in which the ultra-violet and the infra-red are indicated beyond the visible spectrum, it is seen that the "vision" of the camera begins with the ultra-violet at a wave length in the neighborhood of .325 and extends, in the case of panchromatic, orthochromatic, and ordinary plates and films, to .675μ, .590μ and .525μ, respectively. A study of Table 9 and Figure 4 will disclose some interesting facts for those readers who are interested in going deeper into the subject of photography.

AMATEUR PHOTOGRAPHERS who have worried over poor results will be glad to learn the cause of some of the failures experienced. It is very disappointing when a photograph of an impressive visual color setting turns out to be poor. This disappointment is further aggravated by a study of a set of perfectly balanced and wonderfully colored illustrations in current magazines. Therefore, the knowledge that the professional photographer gets these perfect results by using special, chemically treated negatives and films as well as light filters that are not, in general, available for the average amateur photographer, is a great relief.

There are three principal kinds of photographic plates: ordinary, monochromatic, and panchromatic.

Table 9
Color Filters

Kind of Plate	Colors Sensitive to	Colors Partly Sensitive to	Proper Filter to Use	Photographic Subjects
Ordinary	Blue Violet Ultra-Violet			
Monochromatic	Blue Violet Ultra-Violet	Yellow Green Yellow-Green	Yellow	
Panchromatic	All colors		Yellow	
			Strong Yellow	Oak, Walnut, and Similar Woods
			Orange-Red	Mahogany Wood, Rosewood, Violet Typewriting
			Green	Green Typewriting
			Deep Red	Dark Mahogany Wood, Blueprints
			Red	Furniture, Clouds



ORDINARY NEGATIVE

ORTHOCHROMATIC NEGATIVE

PANCHROMATIC NEGATIVE

Figure 15.—THREE ACTUAL PHOTOGRAPHS OF THE CHROMATIC CIRCLE

The chromatic circle has been photographed by each of these plates and the result, shown in Figure 15, tells its story more plainly than words. Orthochromatic films are almost universally furnished for the use of the amateur, while panchromatic plates are not generally available for the use of either roll film cameras or the amateur photographer. Ordinary plates, being the simplest form of negatives, are seldom available at all nowadays.

COLORS THAT DO NOT PHOTOGRAPH WELL have always been a source of dissatisfaction to those who have attempted to reproduce them, and I know of no better way to bring this point out than to show various actual photographs (Figure 15) of the twelve colors in the chromatic circle, which forms the basis of the color theory covered in this book.

VIII

COLOR LANGUAGE

Practical Proof	The Color Story of the American Flag
The Color Choosing Chart	The United States Government
To Give Personality to Colors	The Facts

Practical Proof of the theory adopted by artists and scientists in regard to the language of color lies in the steps through which the physical action passes in the heating of a piece of iron.

The color language of active temperature changing bodies is the reverse of inactive. The heating of a colored surface is seen most vividly and wonderfully by observing the heating of an iron bar in a blacksmith's forge. The steps in color change through which the iron passes (Figure 16) as the temperature is increased from that of the room to melting are illustrated in a composite creation of a visual temperature table made up of the chromatic circle (Figure 6) and the color choosing chart (Figure 17).

At first thought this positive action on the part of a heated body might tend to contradict the color language theory, but when it is realized that all color is the result of reflected light falling upon a surface which appears colored and which changes, depending upon the nature and color of the light source, it is evident the *direct* view rather than the reflected view of a luminous object confirms our language theory.

What could be more convincing than a comparison of the raising of the temperature of a piece of iron from room temperature to the melting stage with the wave-

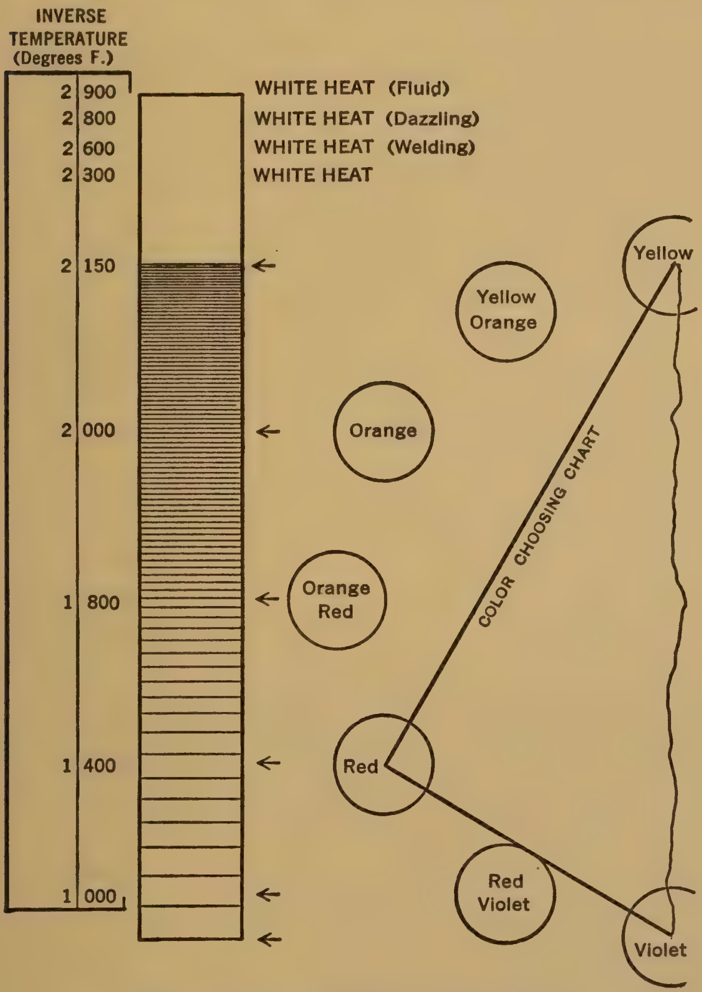


Figure 16.—IRON TEMPERATURE-COLOR SCALE

length diagrams (Figures 3 and 4)? At first the temperature rises through the thermal or heat spectrum in the infra-red portion and then passes into the visible, ocular, or chromatic part, and on up the scale through red, orange, yellow, and finally reaches a white state which brings on a condition of fluidity of the iron.

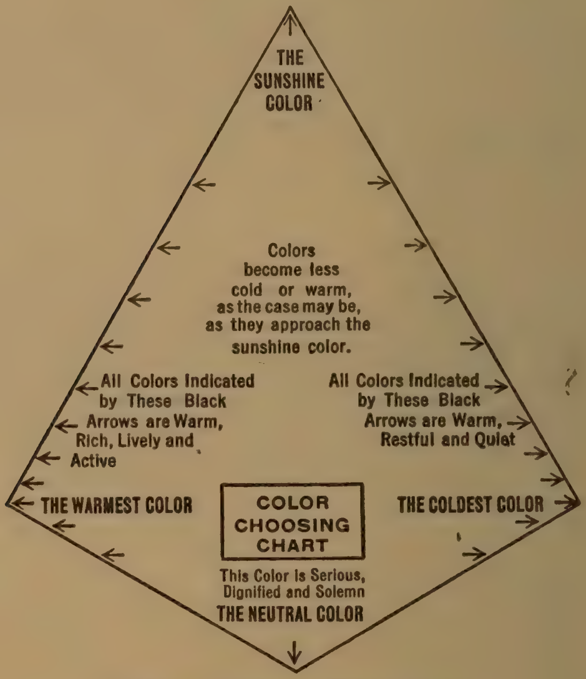

THE SUNSHINE COLOR
Colors become less cold or warm, as the case may be, as they approach the sunshine color.
All Colors Indicated by These Black Arrows are Warm, Rich, Lively and Active
All Colors Indicated by These Black Arrows are Warm, Restful and Quiet
THE WARMEST COLOR
COLOR CHOOSING CHART
THE COLDEST COLOR
This Color Is Serious, Dignified and Solemn
THE NEUTRAL COLOR

Figure 17.—COLOR CHOOSING CHART

THE COLOR CHOOSING CHART (Figure 17) especially when it is reproduced in colors and shaded may be used in connection with the chromatic circle to aid in making a visual analysis of psychological color sensations.

We are living in the age of color. A few years ago everything—furniture, houses, automobiles, and so on—was, as a rule, finished in uninteresting blacks, whites, or one or more of the primary or secondary colors. But color education has been slowly but surely creeping upon us, so that no longer are we satisfied with *just a green finish.* It must be a very pleasing shade or tint or mixture of green with some other color, and above all it must harmonize with other colors that may be used with it.

So important is this change in our lives that never again will we be satisfied to wear just the plain, drab colors of our forefathers.

We may say and may feel that we know nothing whatever of color, but nevertheless we do. As an illustration, one may know nothing about music, yet a discord is readily recognized. So it is with color—discords are also unconsciously observed. As a matter of fact, persons who know nothing about colors, change, fit, and try different combinations until they arrive at one which is pleasing—and it will be found in a large measure that the combinations thus evolved will harmonize. Since psychology has to do with the spiritual rather than the physical, it seems proper that these unexplainable acts on the part of those who are said to be totally void of any color education are justly classified under this heading.

I know of no better way to bring this subject to the attention of the interested reader than to refer to the emblem of our country—The American Flag. Why do we love it? Why do we thrill and forget about everything else in the world when we look up in the sky and study those same colors—the red, the white, the blue? No other nation in the whole world has a flag or an emblem of any kind that can do so much to transcribe its feelings into action—and it is important to note, too, that there are other national emblems in which the same colors are used.

TO GIVE PERSONALITY TO COLORS may be too idealistic, but I like to think of them as individuals with whom I come in contact. There are the colors that are friends, colors that speak in plain terms and are easy to understand. On the other hand, there are those we meet, but do not and cannot understand. The latter might be classified as cold and distant or businesslike, while the former could be described as warm and cordial—persons who by their very presence make everything seem interesting and worth while.

Some folks feel the same way about flowers and are just as happy and contented in their presence as they are in the presence of friendly persons. Of course, color is really at the base of it all, for the modes of both the flowers and the persons who love them change with the change in shades and tints; and finally when all color is gone, a situation analogous to desolation ensues.

THE COLOR STORY OF THE AMERICAN FLAG is most ably told by my friend, the late Wilbur D. Nesbit, in his poem, "Your Flag and My Flag," which I take pleasure in quoting in full.

YOUR FLAG AND MY FLAG

by

WILBUR D. NESBIT

Your flag and my flag,
And how it flies today
In your land and my land
And half a world away!
Rose-red and blood-red
The stripes forever gleam;
Snow-white and soul-white—
The good forefathers' dream;
Sky-blue and true blue, with stars to gleam aright—
The gloried guidon of the day; a shelter through the night.

Your flag and my flag!
To every star and stripe
The drums beat as hearts beat
And fifers shrilly pipe!
Your flag and my flag—
A blessing in the sky;
Your hope and my hope—
It never hid a lie!
Home land and far land and half the world around,
Old Glory hears our glad salute and ripples to the sound!

Your flag and my flag!
And, oh, how much it holds—
Your land and my land—
Secure within its folds!
Your heart and my heart
Beat quicker at the sight;
Sun-kissed and wind-tossed—
Red and blue and white.
The one flag—the great flag—the flag for me and you—
Glorified all else beside—the red and white and blue!

On the fourteenth of June, 1777, Congress resolved, "that the flag of the thirteen United States be thirteen stripes alternate red and white; that the union be thirteen white stars in a blue field representing a new constellation." Of this, Charles Sumner said: ". . . the very colors have a language; white is for purity, red for valor, and blue for justice."

In the *National Geographic,* Charles W. Stewart tells the story a little more elaborately when he says, " . . . red is for courage, zeal, fervency; white is for purity, cleanliness of life, and rectitude of conduct; blue is for loyalty, devotion, friendship, justice, and truth."

Our flag came down to us through a process of evolution, and it will probably never be definitely known just how it was created, but this is certain, that the intermingling of the colors in just the right proportions and after a design that has never been equaled and probably never will be, resulted in a national emblem, the very sight of which spontaneously arouses the hearts of all Americans as nothing else can.

THE UNITED STATES GOVERNMENT, in making maps, believes in the color language theory, as demonstrated by the world map (Figure 18), which tells an interesting visual story of how the United States Shipping Board makes use in a practical way of the language of color. This wonderful map was cast in aluminum sections and was displayed at various points in the United States for public view.

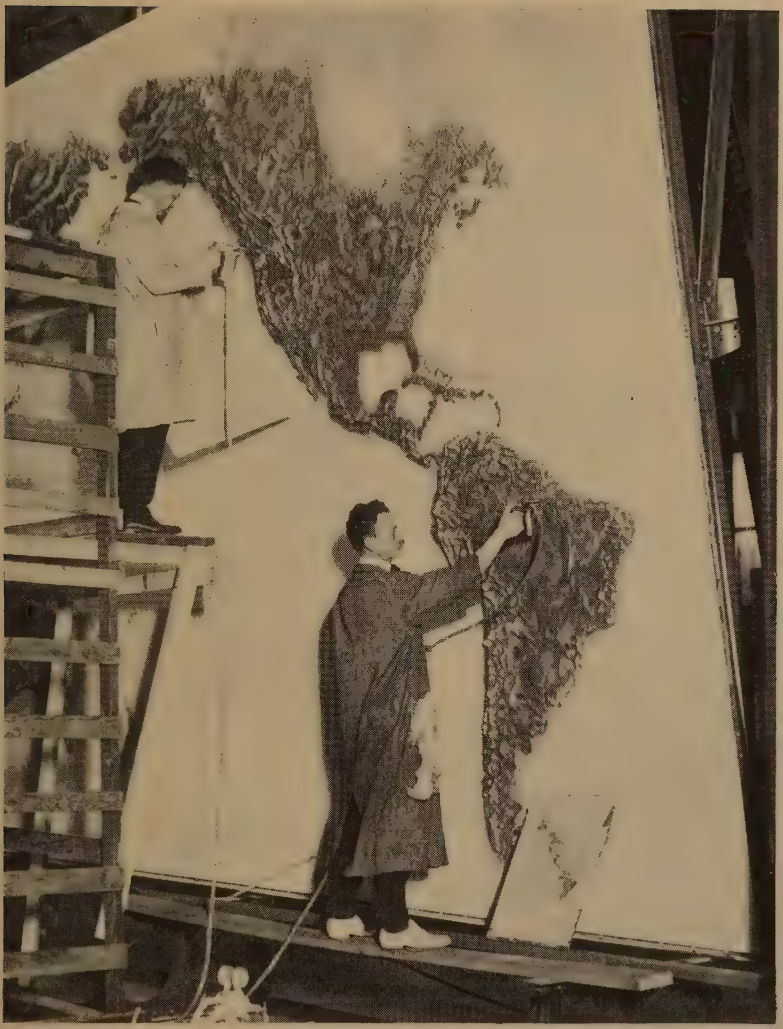


Figure 18.—United States Shipping Board Map of the World

The temperature in different parts of the world, the fertility of the soil, the direction of ocean currents, and so on, were portrayed by the color, intensity, shades, and tints of the paint used. For example, the oceans in the vicinity of the equator were shown blue, and as the distance north and south increased, this blue became lighter and lighter until it finally merged into a green. The Gulf Stream, on the other hand, was shown almost warm, throughout its course, in a blue-violet color.

THE FACTS covering tne language of color are very simple:

Yellow stands out as a delicate color in the company of the other colors illustrated (Figure 16). It also represents gold and wealth.

Red is a warm color. It is exciting. It suggests heat by its very appearance. In art it also represents such things as sin, cruelty, wrath, love, and valor.

Blue seems to have something that is not possessed by either the red or the yellow. It is a cold color. It is modest and retiring and represents also such things as truth, wisdom, loyalty, and even despondency.

White symbolizes innocence, happiness, triumph, light, and purity.

Black portrays darkness, defilement, and mourning.

Green is used to bring out life, hope and, occasionally, jealousy.

IX

COLOR DESIGNATION

THE COLOR OF FACTORY PIPING
COLOR STANDARDIZATION FOR FACTORY SURFACES AND EQUIPMENT
STANDARD COLORS FOR SPRINKLER HEADS
THE COLOR CODE FOR PAIRS OF TELEPHONE WIRES

THE COLOR OF FACTORY PIPING is a topic that has engaged the minds of operators and engineers in almost every kind of manufacturing. I thought the subject of Color had some confusing angles to it when I started to write this book, but be that as it may, there is no question about the confusion that exists in the struggle that has been made for many, many years by such representative groups as the following:

American Society of Mechanical Engineers
National Safety Council
Refrigerating Engineers
Textile Engineers
Power Plant Engineers
Public Utility Companies

All of them have tried to create and standardize a Color Code for Piping, which shows that within these various branches of industry there is a recognized need for such a code.

It was my good fortune to study many reports—some complete, others incomplete—some that were good, others that were given up in despair. Particularly was it my privilege to view this matter from the outside rather than from within, with the result that the simplified code, Table 10, is offered as a basis for a standard that may be followed by those not already bound by a similar system.

It seems that the greatest value in a code of this kind lies in the fact that anyone, be he employee, visitor,

TABLE 10

COLOR CODE FOR FACTORY PIPING

Pipe and Equipment* for		Main Color for Piping	Color Language for the Unions, Valves, and Fittings to Suggest the Pressure, Temperature, Etc.
Air	Free	Gray	———
	Compressed	Gray	Blue
Chemicals	Acid	Orange	Red
	Alkalis	Orange	Green
	Gases	Orange	Blue
Electric	Low Voltage	Black	———
	High Voltage	Black	Red
Fire		Red	Red
Gas	High Pressure	Aluminum	Red
	Low Pressure	Aluminum	———
Oil	Fuel	Violet	———
	Not fuel	Violet	Blue
Paint		Green	Various
Refrigeration		(See Chemicals)	
Sewers, Vents		Black	———
Steam	High Pressure	White	Red
	Low Pressure	White	Orange
	Exhaust	White	Yellow
	Return	White	Violet
Water	Cold	Blue	———
	Drinking	Blue	White
	Hot	Blue	Orange
	Sprinkler	Blue	Red

*Certain associated equipment might also be colored the same as the pipe. For example, air compressors, gray; compressed air pipes, gray.

manager, engineer, superintendent, fireman, or inspector, may look at a set of pipes and be able to tell approximately the purpose of each.

> A committee of about thirty members consisting of representatives of all the various societies has been working on this problem of color identification for about three years. Should their report be made public, the colors in it should be followed in preference to those given in Table 10.

Were I to make criticism of the efforts that have been made along this line it would be that too much detail has been attempted. Needless to say, the Color Code suggested in Table 10 has been evolved by close study of Figure 17 and other information in this book on color language and of the results of others to create a standard code. Take, for example, water pipes—blue is a color that is appropriate for this, although green might have been used, also. With the color language in use, what more appropriate set of colors to tell the story of what kind of water the pipes contain is there than to have the unions, valves, and fittings painted: white to designate pure drinking water; orange to tell that the water is hot; red to denote that that particular line is a part of the sprinkler system; and just plain blue to tell that within is plain cold water?

Again let us look at the colors suggested for steam piping. White is the general color for the entire system—even the engines and the boiler, if one wishes to carry the color scheme that far. The fittings, valves, and flanges are painted red to designate high-pressure lines; orange to show that the pipes contain low-pressure steam; yellow to indicate exhaust steam; and violet to call attention to the fact that the particular steam in that pipe has done its work and is on the way back to the boiler.

COLOR STANDARDIZATION FOR FACTORY SURFACES AND EQUIPMENT is a subject that deserves the most careful consideration on the part of factories that have not already done something along this line. In the following plan (Table 11) an attempt is made to list the more common surfaces and equipment. The colors are omitted, in order that the individual problems may be studied and a color selected for each. Obviously, the number of painting materials used should be reduced to a minimum so that those selected could be ordered in larger quantities. From a management point of view the question of what paint or color to use would be definitely settled and not opened to discussion several times during the year. Best of all, a great improvement in the general appearance of the premises would result.

STANDARD COLORS FOR SPRINKLER HEADS (Table 12) naturally are closely associated with factory piping, and it is indeed interesting to note that in 1905 the National Fire Protection Association adopted standard colors for sprinkler heads which have been in use ever since.

THE COLOR CODE FOR PAIRS OF TELEPHONE WIRES (Table 13), a subject to which the average person gives little thought, is perhaps one of the best examples that

TABLE II
COLOR STANDARDIZATION FOR FACTORY SURFACES (OTHER THAN PIPES)

INTERIOR						EXTERIOR		
Office	Color Number	Color*	Factory	Color Number	Color*	Factory	Color Number	Color*
			Roof	0				
Ceiling	A		Ceiling	1				
Walls	B		Walls	2		Wooden Buildings	I	
Dado	C		Dado	3		Fence	II	
Trim	D		Trim	4		Trim	III	
Doors	E		Doors	5		Doors	IV	
			Pillars	6		Posts	V	
Floors	F		Floors	7				
Radiators†	G		Radiators†	8				
Furniture	H		Furniture	9				
Fans	I		Fans	10				
Fixtures	J		Fixtures	11				
			Machinery Guards	12		Truck Chassis	VI	
			Machinery	13		Truck Body	VII	
			Cranes	14				
			Waste Cans	15		Oil Tanks†	VIII	
Fire Equipment†			Fire Equipment	16		Water Tanks†	IX	
						Fire Equipment†	X	
			Metal Surfaces‡	17		Metal Surfaces‡	XI	

*Choice of colors to be made to fit local conditions.
†Refer to table covering piping.
‡All new metal surfaces, not galvanized or otherwise protected, should be covered with a priming coat of red lead.

TABLE 12

STANDARD COLORS FOR SPRINKLER HEADS

Fusing Point Degrees F	Color of Head
360	Red
286	Blue
212	White
165	Brass

could be given of the money value of colors used in a systematic, practical way. Within a certain telephone cable containing a large number of pairs of wires we find a multiplicity of color combinations, never realizing that that very multiplicity saves the telephone companies thousands and thousands of dollars every year.

TABLE 13

COLOR CODE FOR PAIRS OF TELEPHONE WIRES

Plain Member	Corresponding Colored Member	Plain Member	Corresponding Colored Member
Blue	Blue-White		
	Orange	Blue-White	Blue-Orange
	Green		Green
	Brown		Brown
	Slate		Slate
Orange	Orange-White	Blue-Orange	Blue-Green
	Green		Brown
	Brown		Slate
	Slate	Blue-Green	Blue-Brown
Green	Green-White		Slate
	Brown	Blue-Brown	Blue-Slate
	Slate	Orange-White	Orange-Green
Brown	Brown-White		Brown
	Slate		Slate
Slate	Slate-White	and so on.	

If one will stop and ponder at the miles and miles of pairs of wires that are strung all over this and other lands and try to realize how they are all kept in order with apparently no confusion, he will conclude that some sort of a standardized code is absolutely necessary in order that the workmen at one end of a cable may know what wire to pick up in order to match it up with the proper one at the other end.

This code may suggest something to engineers in other lines of industry that may result in a saving of labor either in installation or in maintenance. Of course, it is understood that the color scheme covering telephone wires is introduced in the silk and cotton covering of the wire when it is manufactured. For example, the first pair in the table is blue and blue-white, the only difference between the two wires of the pair being a white strand or thread worked in with the solid blue to indicate a slight difference that may be easily recognized by those familiar with the color code.

Indeed, a study of most radio sets will disclose the use of a color code covering the winding used. Obviously, this simplifies the matching of the connections and the locating of troubles for the person not thoroughly versed in radio engineering.

X

COLOR PIGMENTS*

- BLUES
  - Chinese
  - Cobalt
  - Milori
  - Prussian
  - Ultramarine
- BRONZES
- BROWNS
  - Metallic
  - Vandyke
  - Sepia
- GREENS
  - Chrome
  - Emeraude
  - Emerald
  - Verdigris
- LAKES
  - Carmine
  - Madder
  - Rose
- LEADS
  - Blue
  - Red
- REDS
  - Indian
  - Lithol
  - Para
  - Toluidine
  - Tuscan
  - Venetian
- SIENNAS
  - Raw
  - Burnt
- UMBERS
  - Burnt
  - Raw
- VERMILLION
- VERMILLION
  - American
- YELLOWS
  - Chrome
  - Ochre

The color pigments described below, except those that are specifically mentioned as being derived from coal-tar or from the vegetable kingdom, are to be found in Mother Earth.

It should be observed that materials classified as paint pigments have been from time immemorial taken from the earth and used straight after perhaps a chemical or a heat treatment. Along with them seem to go the general characteristics of dependability and durability. Then the coal-tar products began to come in as a result

---

N. B.—In this chapter an attempt has been made to clarify the names of colored pigments from a practical standpoint. The duplicate names following the title are not really synonymous with the principal ones at the head of the paragraph, otherwise there would not have developed two names to cover exactly the same thing. There are slight differences to prove the identity of most of the secondary names mentioned.

*See Color Plate VI.

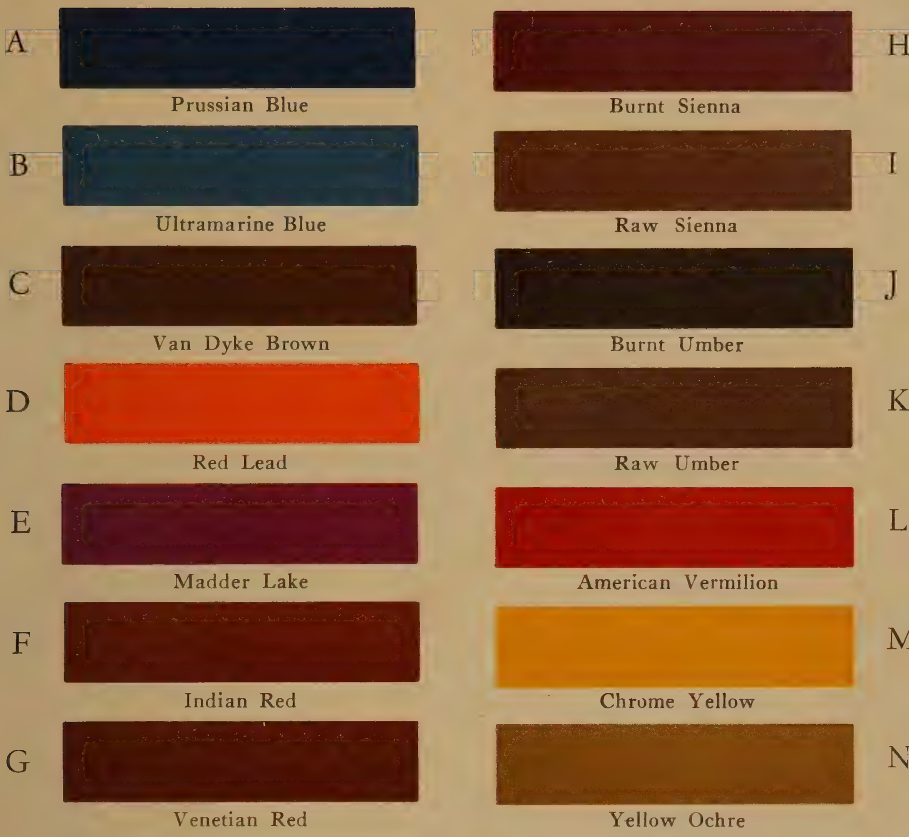
of new requirements and new discoveries in organic chemistry, and as a consequence more of the scarce and difficult-to-handle pigments of the past have been supplanted by a modern *chemical* pigment—and new ones are being discovered right along.

BLUE (*Chinese*), also called soluble blue, differs from Prussian blue in that it is soluble in water, its principal use being in the manufacture of bluing. In paints it gives a clear blue undertone.

BLUE (*Cobalt*) is substantially the same as ultramarine blue. It is a compound consisting of oxides of aluminum and cobalt. It is blue-green in color and is permanent to light. It is not affected by alkali, lime or acids, and can be mixed with any other pigment or color. Because of the high price of genuine cobalt blue, the so-called cobalt blue usually found on the market is a suitable ultramarine blue, and when mixed with a little zinc white it gives a very close imitation of the true cobalt. Cobalt blue is used extensively in the ceramic industry. There results a chemical action between the sulphur entering into the process of manufacturing of cobalt blue and white lead which changes the *white* lead carbonate to *black* lead sulphide. It darkens when baked above 225 degrees F.

BLUE (*Milori*) is similar to Prussian blue and is said to be free from the bronze tone that often appears in blue materials.

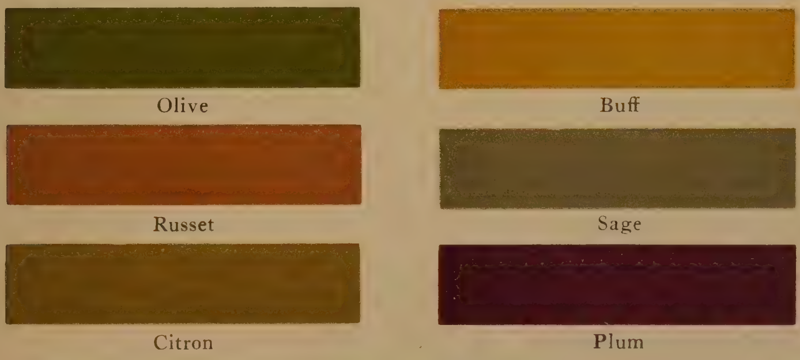
BLUE (*Prussian*), also called Turner's blue, Steel blue, Iron blue, Antwerp blue, Berlin blue, and Saxon



The following colors are a part of Figure 9:

Tertiary Colors

Quaternary Colors



Color Plate VI.—Popular Color Pigments

blue (Color A), is formed by precipitating potassium or sodium compounds with ferrous sulphate and oxidizing the resulting pale bluish precipitate by air into the characteristic dark blue of this pigment. There are many closely related varieties, depending on details of treatment in their production. Prussian blue is a pigment of great strength, one pound giving a decided light blue tint to a ton of white lead. It has a dark top tone and a red undertone. It is fairly permanent except in contact with alkalies or lime, which decolorize it rapidly. *This fact makes it impractical for use on plaster because it fades and spots.* With white pigments it should give a decided blue tint, not violet or muddy. Being very fine in texture it does not settle in the vehicle and hence has been used by implement manufacturers as a dipping paint for polished steel parts.

It is fugitive and therefore not good for exterior painting. Where a permanent Prussian blue is required, it may be made by mixing emeraude green and ultramarine blue.

BLUE (*Ultramarine*), also called Permanent blue, New blue, French blue, Lapis lazuli (Color B), was originally made of a valuable stone but is now made artificially in large quantities and at low cost by heating together clay, silica, sodium carbonate, sodium sulphate, charcoal, rosin, and sulphur, and treating the product by rather intricate processes of grinding, roasting and washing. It is bright but of low color strength —varying from a pure blue to colors bordering on green, the latter being called *green ultramarine.* It is permanent when exposed to sunlight, alkali, or lime, but it is affected by even weak acids. *The sulphur in ultramarine darkens white lead carbonate and discolors chrome yellow and other colors containing lead.* It is used largely in house painting, that is, for making tints with zinc white. This pigment may be used safely on new plaster or cement walls, since alkalis do not affect it.

As in the case of cobalt blue, there results a chemical action between the sulphur entering into the process of manufacturing of ultramarine blue and white lead which changes the *white* lead carbonate to *black* lead sulphide.

BRONZES are very finely divided metals or alloys. They are used in so-called bronze paints and are known under various names which may indicate either the composition of the material, as in *aluminum bronze,* which is metallic aluminum, or in *copper bronze,* which is metallic copper, or the appearance, as in *gold bronze,* which is the term applied to finely divided alloys of copper, zinc, and tin, which have colors resembling gold. Bronze powders generally contain small amounts of oil or fatty matter, such as stearin. They may be obtained in several colors, such as orange, blue, red, and yellow.

BROWN (*Metallic*), also called Mineral brown, is made from native iron ores mined in many localities. Upon roasting, it develops colors ranging from bright red-brown to dark violet. These are used extensively for roofs, barns, iron bridges, freight cars, and similar work where a good substantial covering is required without much regard to beauty. They are opaque and fairly permanent, changing little on exposure. They mix with other pigments with good results.

BROWN (*Vandyke*), also known as Cassel earth, Cologne earth, Sap brown (Color C), is a pigment of carbonaceous character usually found in or near bogs. Its distinguishing feature is its solubility in dilute alkali, forming a solution which may be applied to wood and precipitated in the grain with dilute acid, giving a very good and permanent walnut stain. A dry soluble form is marketed as sap brown. Vandyke brown, ground in oil and thinned with turpentine, makes a good walnut oil stain which is not too transparent and is decidedly permanent. Its one objectionable feature is its very strong retardation of the drying in linseed oil. The color of Vandyke brown may also be obtained by using burnt umber, drop black, and Prussian blue, producing a color that is permanent but lacking the transparency of true Vandyke brown.

BROWN (*Sepia*) is used very largely for photographic purposes. It is not at all permanent to light. Basically, it is made from cuttle fish, but more permanent forms of it are mixed from other colors. It is not a pigment, but is listed here for general information.

GREEN (*Chrome*), also called Brunswick green, Bremen green, can be made by simply mixing together

Prussian blue and chrome yellow. In color work the necessary solutions to produce both Prussian blue and chrome yellow are made up and then mixed together, the resulting chrome green being a very intimate mixture of the blue and yellow. In tone these mixtures range from very pale yellow-green to very deep blue-green. They have great covering power and good color strength but are not very durable and are subject to the limitations of both Prussian blue and chrome yellow. Because of its great hiding power and color strength it has become common to put out green of a commercial grade. This is made out of a pigment which consists of about 75% of barytes or silicate and 25% of color. For body finishing this answers well, but for tinting the chemically pure green is preferred. *Lime will turn chrome-green yellow, since the Prussian blue in it is destroyed.*

From the above it will be inferred, and rightly so, that in mixing tints and shades of green it is better to use chrome green than to use yellow and blue mixed. In other words, we have in one case a perfect chemical compound and in the other just a mechanical mixture. Also, this accounts to a certain extent for the fading of some green paints soon after they are applied.

Chrome greens in which raw umber is used are not permanent to sunlight.

GREEN (*Emeraude*), also called Irridian green, is very permanent to lights, chemically sound and a very good mixer.

GREEN (*Emerald*) is copper aceto-arsenite extensively used as an insecticide. Because of its poisonous nature its use as a paint pigment has almost entirely ceased, even though it possesses a fine brilliant color. As a rule it does not agree chemically when mixed with other pigments.

GREEN (*Verdigris*) is a basic acetate of copper of pale bluish-green color, not permanent, but used to some extent for decorative effects and in marine paints as a protection against barnacles (shell fish). *It is especially affected chemically by sulphur fumes* and is also fugitive to light.

LAKE (*Carmine*) is not so important today. It is derived from an insect called the cochineal. It is very unstable. Being an expensive color, its use is confined to decorative touches and where small quantities may be used. *It is very transparent, which means that its covering power is very low.*

LAKE (*Madder*), also called Rose doré, Scarlet madder, Rose madder (Color E), is a true pigment of vegetable origin which possesses color and opaqueness. It is insoluble in the medium in which it is used, thereby differing from dyestuffs, which are soluble. It was produced originally from a coloring made from the extract of madder root, but it is now made from coal-tar. Also, like Carmine lake, it is an expensive color and its use is confined to decorative purposes where small quantities are used.

Alizarine lake is the coal-tar product which has largely taken its place.

LAKE (*Rose*), also called Rose pink, is made from Brazil wood as well as from coal-tar.

All lakes are fugitive when exposed outside. When protected by varnish they last much longer. They produce very fine, rich, wine-colored and maroon hues.

LEAD (*Blue*) is not a pigment in itself. It is a by-product of lead.

LEAD (*Red*), also called Minium, (Color D) is a crystalline pigment which will not grind in linseed oil on account of its structure. It is seldom ground fine, even in a dry state. Its tone would be greatly reduced if this were done. It hardens to a marked degree, on account of saponifying with the oil, and is never mixed until needed. It is produced by oxidization of litharges. Its principal use is for first coating on metal. *It is not of much use as a color, since it fades.*

RED (*Indian*) (Color F) was formerly obtained as a natural iron ore but is now largely produced artificially by roasting ferrous sulphate (green vitrol). Indian red is of a dark violet color and should contain at least 95% of ferric oxide. It affords pure tints with white, for which purpose it is much used. It is very permanent, not being affected by light or by other pigments with which it is mixed. It is very opaque when used for body and may be extended by the addition of large proportions of inert material and still cover well.

RED (*Lithol*) is a coal-tar product having a bluish cast. It is supposed to be non-bleeding.

RED (*Para*) is a coal-tar product and very extensively used, since it has wonderful covering qualities in proportion to the amount used. *It can even be made to cover black in one coat.* However, all is not virtue with it, for *it has a great tendency to bleed because it is soluble in oil.*

RED (*Toluidine*) is a coal-tar product. It is similar to para red but lighter. *It is very permanent and does not bleed.* Also, it is more expensive than para red. Oil companies are partial to it, because it stands exposure.

RED (*Tuscan*) is compounded with Indian red and certain lakes mixed with whiting or china clay, which gives it a beautiful subdued crimson tone. It is marketed in three shades: light, medium, and dark. *When made of poor materials or analines it is very unstable, but the modern coal-tar is a permanent article that will stand sunlight and 300 degrees F. in baking enamels.* Because of its great strength it is usually reduced by mixing with barytes, whiting, or gypsum. It has largely displaced Indian red, which was formerly used extensively by railroad and implement manufacturers.

RED (*Venetian*) (Color G), while it formerly consisted of natural earths which possessed a reddish color due to oxide of iron, is now produced almost exclusively by artificial means. The better grades are made by heating ferrous sulphate as in the production of Indian red. This calcined product is then mixed with gypsum, barytes, or whiting. A solution of ferrous sulphate may be treated with lime water and the precipitate calcined; or ferrous sulphate and oyster shells may be used, thus giving an intimate mixture of ferric oxide and dead burnt calcium sulphate. Good Venetian red can be used for any kind of painting in oil or distemper. It has excellent body and, if free from whiting, has great permanency and can be safely mixed with any other pigment. Its color is always the characteristic brick red. It is used very widely when an inexpensive and reliable pigment is needed.

SIENNA (*Raw*) (Color I) was originally obtained in Italy. In fact, the best grades are still called Italian. They resemble ochres in their general composition, being earthly substances colored by hydrated iron oxide. There is usually also a little manganese oxide present. They are brownish yellow in color and quite transparent, a fact which renders them undesirable for body colors but makes them invaluable as staining and graining colors. Mixed with white they produce beautiful cream tints and have greater color strength than ochres. They are permanent and can be used with any vehicle or pigment. They are free from aluminum and are not affected by sunlight or weather. They mix well with other pigments. Their chief use is in color mixing and toning on account of transparency.

SIENNA (*Burnt*) (Color H) is the same as raw sienna except that the heating process changes the ferric oxide to red oxide by dehydration. It is not affected by sunlight or climatic conditions. It mixes well with other pigments. It is used chiefly in color mixing and toning on account of its transparency. It could have been placed in the red classification. It becomes a dark red brown when ground in oil. Two kinds are in use: house painters' burnt sienna, which is strong in coloring matter and opaque and intended to serve as a tinting color; grainers' burnt sienna, chosen for its transparency, richness, and clearness and used as a body color, especially in graining, its color being a characteristic cherry. It is also much used for the conventional mahogany, but for this purpose is generally strengthened in reddish tone by adding lake or similar red colors. Burnt sienna withstands 356 degrees F. without changing color.

UMBER (*Burnt*) (Color J) is obtained by calcining raw umber. It has a rich brown color free from redness. Its use is the same as that of raw umber. Extensively used in stains, glazing colors, and for graining.

UMBER (*Raw*) (Color K) is a natural earth pigment of yellowish-brown color with an olive tone similar in composition to the siennas, but containing considerable amounts of manganese oxide. The best grade comes from Cyprus. Raw umber is permanent, mixes well with vehicles, is of medium capacity, fair strength, and is much used as a tinting color. It is colored by manganese dioxide and also brown ferric oxide. A test for purity is to grind a small amount into some oil and spread the mixture on a piece of plate glass. The unadulterated article will have a green tone that will not fade. Some of the poorest grades are made from decomposed coal. These are adulterations and should not be classed as umbers.

VERMILLION, also called English vermillion, Quicksilver vermillion, is a mercury sulphide made by mixing 84 parts of quicksilver with 16 parts of sulphur, which at first comes out black, but subsequent treatment brings out a beautiful red tone. Being very heavy it does not stay in suspension in oil. *Care must be taken to see that it does not turn black again,* which it will do if not protected by a varnish coat. However, the coal-tar vermillion substitute has almost wholly displaced the mercury type on account of its better permanency as well as lower cost.

VERMILLION (*American*), also called Scarlet Lead Chromate, Chrome red (Color L), is a basic chromate of lead. It is a brilliant red, coarsely crystalline powder, which possesses good hiding power and color strength. Grinding turns it a dull yellow. *It is fairly permanent to light but is blackened by sulphides.* It is still sometimes used as a color pigment, though its place is largely taken by the coal-tar red. As a protective pigment in paints for iron and steel it equals or excels red lead, but its cost prevents its wide use. It is quite different in color from the Chinese, English, and French vermillions made by compounding mercury and sulphur. These latter, being more expensive, are mostly confined to use in artistic work. If baked over 200 degrees F. it tends to turn brown.

YELLOW (*Chrome*), also called Chromate of Lead, Medium Chrome Yellow (Color M), is compounded from bichromate of potash or soda and a lead salt. It is fairly stable in sunlight but will turn black in the presence of sulphurated hydrogen. This accounts in part for the darker shade when baked, especially with open flame gas, which contains sulphur. All chrome yellows are colors of considerable brilliance, good strength, and hiding power. They are fairly durable, but slowly affected by atmospheric conditions. *Sulphides turn them black, hence ultramarine blue, which contains sulphide, must not be mixed with chrome yellows. Chrome yellows cannot be used with silicate of soda, lime, or other alkaline substance, for these turn them orange or red.*

The *light* grade is made by adding sodium sulphate to the above, while the *dark* grade is made by adding an alkali to the above. When baked over 225 degrees F. it tends to turn brown.

YELLOW OCHRE (Color N) is a natural earth; grades of it are found in all parts of the world. In color it varies from citron to almost olive. The coloring matter is hydrated oxide of iron. Various ochres contain from 10% to 60% of hydrated oxide, the remainder being siliceous matter or clay. The best grades are darker and are called French and English. American ochres range from those that are fairly good, though lacking in opacity, brightness, tinting, power, and freedom from grit, to those that are simply yellow mud. When of good quality they are excellent pigments, work well with all vehicles and with other pigments, and are permanent in color. Mixed with white they produce fine cream and buff tints. Golden ochre is ochre strengthened in color and given a yellow tone by the addition of chrome yellow. At first this is brighter than ordinary ochre, but the chrome yellow fades after a time, leaving only the natural effect.

XI

COLOR TESTING

Fastness When Exposed to Light
Ultra-Violet Radiation
Lithographic Colors
Printed Matter
Advertising Appropriations
Dyestuff Colors
Sales Argument Proof of Quality
Housefurnishings
Weathering of a Color
Photographs
Lacquers

Much has been accomplished to aid modern science in the investigation and study of the durability of colors, whether inks, paints, lacquers, textiles, paper, or what not. Certain invaluable devices and instruments have been developed to show the various characteristics of these colored materials after they are placed in service. While these instruments form an extremely necessary part of the devices needed, the availability of other laboratory equipment, such as delicate scales, high-powered microscopes, and so on, is also very important.

Fastness When Exposed to Light is one of the characteristics that must be carefully studied, and this is done with a very ingenious mechanical device, Figure 19, in which the violet-carbon arc is an important part. This arc is surrounded by a thermo glass globe, since the combination of these two creates a condition for testing that is even better than actual sunlight, because they make up a positive standard, dependable and accurate and not disturbed by irregular variables such as wind, rain, clouds, changes in temperature, and so on. In this device or machine is provided a means to compare a set of samples under test with samples of other material, the characteristics of which are known.

Thus, the fadometer, as this device is often called, aids in many ways, such as improving the quality of products, preventing disappointment after the colored materials are put to use, and anticipating color discords that may come about as a result of the fading out of one of the colors in a three or more color combination. Through its use manufacturers of certain materials are able to do something that was never possible before—check the color characteristics of the materials while they are *in the process of manufacture* instead of having to wait days and even weeks after their manufacture is complete to learn the result of actual exposure-to-weather tests. This machine will even give rough indications of the absolute failure of certain bad samples within a few hours!

Some materials require longer exposure than others, but it makes no difference what time period is required—the machine may be started and its operation carried on either continuously or interruptedly for a day, a week or a month as desired, depending upon the actual known conditions existing in and about the material under test. In some cases the matter of humidity and change of air currents on the samples must also be considered.

ULTRA-VIOLET RADIATION enclosed in an expensive quartz-glass tube will fade certain dyes very quickly, thus giving a rapid acceleration test. It has its uses in the laboratory under proper direction, so it is also important to have an ultra-violet light available in case it is needed. (Also, refer to Table 8).

LITHOGRAPHIC COLORS are subject to certain factors, some of which have been outlined by the chief chemist of a large user of lithographic displays and included in the following:

1. Action of sunlight
2. Temperature
3. Humidity
4. Amount of rainfall
5. Direction of the wind
6. Velocity of the wind
7. Amount of dust in the air
8. Darkening of the paper from exposure
9. Concentration of the color used
10. Thickness of the ink used
11. Quality of the ink used
12. Texture of the paper used
13. Angle of exposure

PRINTED MATTER, although used mostly indoors, is subject to wide variations in fading (Table 14) which means that a buyer should know just what a seller is delivering or going to deliver to him.

ADVERTISING APPROPRIATIONS are sometimes very large, and a few dollars spent in investigating the color quality of the materials will save many dollars in return from such expenditure. In a large lithograph posting campaign costing $250,000, about 10% represents actual cost of the posters. Assuming that the maker would allow a claim for defective work, it would come out of the $25,000 and not out of the balance of the fund, which is in reality just as much affected as the rest. This proves that care at the start is the best protection.

Table 14

Fading of Colors in Printing and Lithographing

Machine Hours	Equivalent to Actual Exposure Of			
1	12.5 days	4.2 days	1.9 days	.7 days
5	62.0 "	21.0 "	9·5 "	3·5 "
10	125.0 "	42.0 "	19.0 "	7.0 "
25	312.0 "	105.0 "	48.0 "	18.0 "
50	625.0 "	210.0 "	95.0 "	35.0 "
100	1250.0 "	420.0 "	190.0 "	70.0 "
During the Months	Jan. Nov. Dec.	Feb. March Oct.	April May Sept.	June July Aug.

Figures given are for Chicago (Latitude 41° 30′ N).

Dyestuff Colors (Table 15), both of domestic and foreign make, may be checked as shipment is received to make sure that the dye complies with the purchase specifications before being placed in process. A customer's objection to defective color may be answered with test dates already compiled and on file. Thus is avoided the use of fugitive colors in clothing, yarn, dress materials, paints, lacquers, and so on.

Sales Argument Proof of Quality is just another possibility that may be included in the field for color testing. Suppose several bidders are fighting hard to get a certain job. It might involve the use of dyes, paint, ink—whatever the color material. Suppose the figures are all close and the buyer is at loss to know which seller to select and that one of them does something a little out of the ordinary—submits samples of his product already tested for *fastness when exposed to light* accompanied by certain suitable guaranties—something that the other competitors have overlooked and cannot comply with on account of the shortness of time. Who is likely to get the order?

Table 15
Fading of Dyed Textiles

Machine Hours	Equivalent to Actual Exposure Of			
1	3.3 days	1.1 days	.5 days	.17 days
5	16.3 "	5.5 "	2.5 "	.85 "
10	33.0 "	11.0 "	5.0 "	1.7 "
25	83.0 "	27.3 "	12.3 "	4.3 "
50	165.0 "	55.0 "	25.0 "	8.5 "
100	325.0 "	110.0 "	50.0 "	17.0 "
During the Months	Jan. Nov. Dec.	Feb. March Oct.	April May Sept.	June July Aug.

Figures given are for Chicago (Latitude 41° 30′ N).

Housefurnishings at one time had to be protected so that the sun would not fade them. Our mothers, it will be recalled, were very careful to keep the shades down, so that the plush on the parlor sofa or the color of the carpet on the floor would not change in spots and become conspicuous. With the use of color coming into wide prominence, sunfast colors are in great demand and the articles that we buy today must stand up very well for at least a year under the most severe treatment.

WEATHERING OF A COLOR or of any other material, for that matter, may be defined as a very severe fading test where the actual durability of the material itself is involved, as well as any change that may take place in the color. A machine, Figure 20, for testing colors under these conditions requires close attention to a number of important details not considered in the machine for testing the fading of colors.

Some of these details are:

1. A wind attachment
2. A rain attachment
3. A humidity attachment
4. Means for combining the above at will
5. Means for producing lower than room temperature
6. Means for uniformly revolving the test samples

In such a machine it must be possible to duplicate conditions as they exist in any part of the world. Should a manufacturer in the United States make something for a customer in Australia, he wants to be assured that there will be no objection to the fading or the durability of the color or material after it is placed in service in Australia.

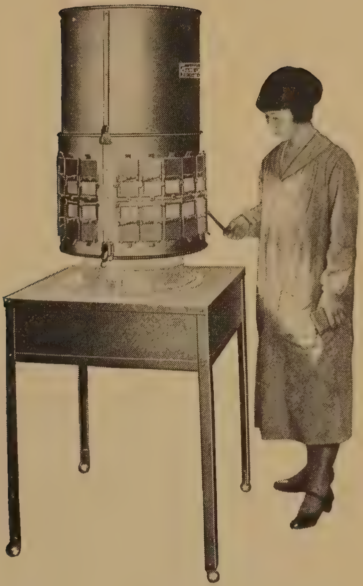


Figure 19.—A Machine That Produces Standardized Sunlight

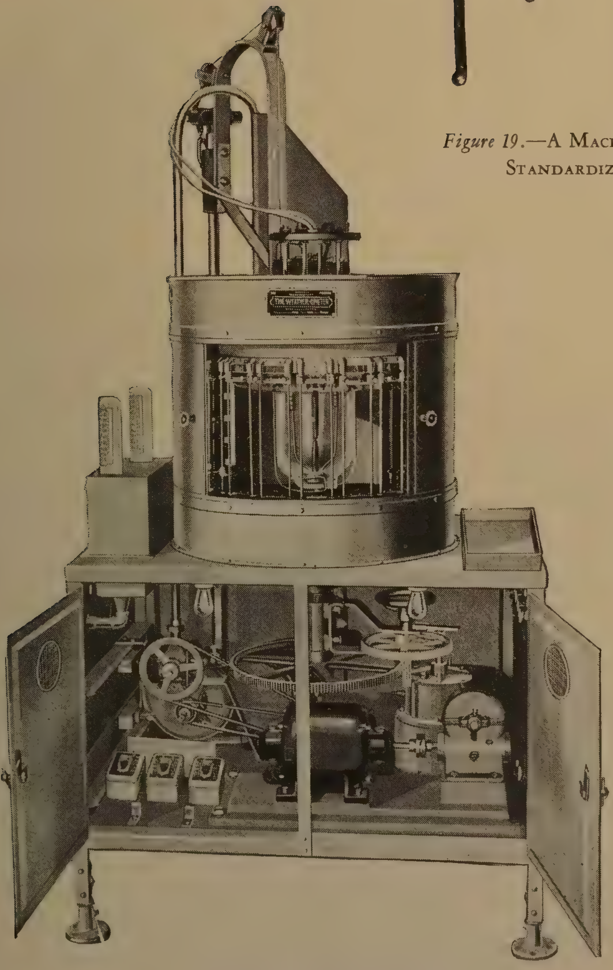


Figure 20.—A Weathering Machine

With a machine of this kind one is able to predetermine the weather-resisting qualities of lacquers, paints, color, and other varnishes, even of roofing materials, rubber and metals or any material that is intended for outdoor use.

The samples are placed on a rotating device which carries them through well-regulated periods of sunshine, rain, coolness, darkness, once every 12 or 24 hours, depending upon the plans for the material under test. The test may be continued for an hour, a day, a month, or a year, either day only or day and night—the period best suited to give the desired final result.

PHOTOGRAPHS of the test plates disclose valuable information, especially if they are enlarged. Since some of the weathering tests indicate what will happen to certain finishing materials after a number of years' exposure, it is possible to anticipate that there might be some valuable information gained from a study of what happens to these long wearing materials at regular intervals during their useful life. Modern microscopy and photography combined may be used to very good advantage in this instance not only as records of the history of a test, but as permanent records to take the place of unstable test plates that are themselves so susceptible to chemical and climatic changes.

LACQUERS are becoming very popular, and their use is running into investments of considerable proportion. Already they have been specified in the finishing of entire buildings. Their general characteristics warrant their use, provided their extra cost can be reconciled. However, it is exceedingly important that the correct lacquer be chosen and that tests on it be made from time to time as the job is being finished so that there will be no possibility of a mistake in its use. Only those having a colored pigment may be used outside, but clear lacquers may and will be used very extensively in the future for interior finishing.

XII

COLOR AND BUSINESS

WILLIAM SHAKESPEARE
THE THEATER
POOR RETURNS FROM ADVERTISING
PERSONAL PREFERENCE
SELECTING AN AUTOMOBILE
A NEW USE FOR COLOR
DECORATIVE DETAILS
HOME FURNISHINGS
THE REWARD

WILLIAM SHAKESPEARE wrote:

"All the world's a stage,
And all the men and women merely players;
They have their exits and their entrances;
And one man in his time plays many parts—."

What a fund of wonderful philosophy and truth in those four lines. One could almost interpret them as a sermon directed at the modern business man. Need we wonder, after reading "As You Like It" and some of the other masterpieces produced by this author of authors what the mental picture was that passed through the mind of this great man as he wrote the very first line—"All the world's a stage,—"?

Could it have been possible for that mind to see "All the men and women merely players" without visualizing to some extent the color of their hair, of their eyes, of the clothing they wore, of their stage setting? Could it have been possible that "their exits and their entrances" appeared alike in color to this master?

Could the man who was so observing as to write the soothing descriptive phrase—also from "As You Like It"—"the beetle with his drowsy hums," have overlooked the story of beauty, of discord, the history of peoples, their customs and habits as played by color in its part of life's drama?

Shakespeare's father was a business man. Were he living in our day he would be classified as a jobber, perhaps as a general jobber, for he dealt in meat, corn, malt, wool, leather, and farm products. Incidentally, he rose from the station of a private citizen in his community to that of alderman and finally bailiff, which would correspond to the mayor of our time. All this environment, coupled with its varied public contacts that were evident from the variety of things handled, gave the son, William, up to the age of eight or nine years, when the father met with financial reverses, a remarkable opportunity to study human nature.

His own words describing a boy of that age as

> "——The whining school-boy, with his satchel
> And shining morning face, creeping like snail
> Unwillingly to school."

substantially contain the confession that things other than school were in his mind.

What William did in early life matters little; the fact is apparent that he was wide awake to the life and activity around him and lost no opportunity to observe the natural scenery surrounding these. His knowledge of color, of human nature, and of the physical world of beauty continued to grow and to enlarge.

Shakespearian scholars say that he wrote with so flowing a pen that his manuscript was never defaced by alteration or erasure. (I wish I could be that perfect.) True to his own writing, he was partial to the open-air stage—another point that calls forth much deserving praise—for the Creator was his scenic artist.

It is recorded that his first job was that of holding horses for men of fashion while they attended the theater. This gave him a good opportunity to observe color and harmony and good taste in dress. Later he became an actor and still later a writer. It is a well-known fact that the theater of that day was without elaborate scenery, from which one might infer that the actors from necessity had to deliver their lines especially well. Logically, colored clothes and the aid of Mother Nature were available at that time and were no doubt utilized to their fullest extent—just as the wonderful color effects of modern theatrical lighting are worked into the staging of the play and share greatly in unfolding the true phases of the story. The coloring of motion picture films, the colored lighting of the theater itself, even the coordination of the music, all form a very necessary network of operations that aid in making the public leave the theater so well pleased that they are glad to return to the same playhouse again and again.

THE THEATER is a place where we go for pleasure. Indeed, it seems to be a national trait that we are interested in enjoyment only. Then, when we attend to our profession or trade we concentrate on our work intensely, so much so, I am afraid, that we even overlook many improvements that might be introduced into our business. In short, we do not witness a pleasing theatrical production for the purpose of trying to pick out the things in it that will help us in our business. Rather we are inclined to forget business entirely for the time being.

Yet, the fact that the theaters have solved the problem of holding our attention and interest indefinitely must have a good sound basic foundation that may possibly hold something of very vital interest for those of us who have to make a living out of something that is also sold to the public—the theater sells amusement; we may sell something else that the public needs—it may be clothing; it may be furniture; it may be food; it may be automobiles; in fact, it may be anything that the public demands. Therefore, is it not logical to assume that if the theater has found the use of color so vital to its existence, it also has some very important uses yet to be discovered in many other lines of business?

POOR RETURNS FROM ADVERTISING worried a certain oil man. I will venture the bold assertion that there are not many lines of business where color does not play a very important part, not even excluding the oil business. Who would answer that color could aid or hinder the sale of gasoline?

It may sound like a myth when I say that a friend of mine, a sophomore in a large university, who happened to be relating to me a conversation that he had had with the head of the advertising department of a large oil company, touched a sensitive chord when he asked: "What could this man have meant by saying, in answer to my request for a temporary summer job in the advertising department, 'We do not need more men in the advertising department, we have too many now as it is—what we do need is someone to tell us why we do not get more business for the amount of money we spend in advertising; why we do not get as high a return from our advertising as our competitors do?' "

"Why," I said, "that particular firm—one of the country's largest and best oil producers—actually drives business away because such a discordant color scheme is used in painting its filling stations. Its product, no doubt, is just as good and possibly better than many competitive kinds. Quick, courteous and commendable service is rendered, but the company does not get more business because of the faulty standardized color scheme used in painting its properties throughout the country. The fault is not so serious as to require an entire change in the colors used, for that would mean throwing away thousands and thousands of dollars invested in popularizing the company's name, brand and goodwill. That would be tantamount to going into bankruptcy and starting all over again, which naturally would not be either practical or possible to bring about."

It so happens that the colors used in this particular case may still be used and the present color scheme retained and made pleasing to the public in a very simple way.

Indeed, the company's advertising would not have to be changed or affected one iota, and even the public would hardly realize that a change had been made. However, it would be found that the removal of this discordance would have the effect of placing a welcome sign on the door and would actually increase sales.

Personal Preference whether we realize it or not governs our very lives. As previously stated, those who do not know much about color will not be governed or concerned with changes in color combinations or color discords, but that is erroneous, for a color discord affects all eyes very much the same as a discordant musical note affects the ear of a listener. A person may not know anything about music, yet he will invariably observe something wrong when a discord is sounded. He may not be able to tell what it is that is wrong or why, but one thing is certain; he will know that all is not right.

Take another instance. Suppose two equally pretty young girls—twins—are walking down the street. One of them is dressed in clothes that are perfectly color-blended; the other wears exactly the same design of clothes, with the exception that the colors have purposely been made to clash. The question is, will the average person, not versed in the theory of color harmony, divide his attention equally between the two girls or will he continue to look at the girl that is harmoniously dressed or will he rest his eyes on the one who is discordantly dressed and ignore her sister?

Still another instance—select one hundred men and women at random. Lead them up to a counter on which are displayed two paintings of a single rose; one colored in harmony and the other full of color discord. Ask each one to pick out the one he likes the best and record the answer. As soon as the test has been completed, it will likely be found that about 75 prefer the harmoniously colored rose while the balance will have selected the discordant rose.

SELECTING AN AUTOMOBILE without being influenced by color is almost impossible. Let one be placed, for example, in the position of having to choose between two types of cars, assuming that all other points, with the exception of appearance, were equally balanced. Were the choice to be made out in the country, perhaps the dark finish would win. Should the choice be made in the city, it is almost certain that the colored model would win, for a number of reasons: everyone else seems to be getting colored cars; the city folks are dressing more colorfully now and education in color has taken a new hold on them; the almost universal use of black in finishing cars, over the period of years just passed, has made the absence of color too common. As a further evidence that color has something to do with a change in the production leadership, it is interesting to note that low priced cars may now be had in pleasing color combinations.

A New Use for Color is developed almost every day. To prove this—as I was passing the Union Station in Chicago a few days ago, I observed crowds climbing up on the bridge overhead to view something of great interest below. It might have been a man overboard, but it wasn't. *It was a locomotive painted in colors!* Who of us ever saw a colored locomotive? Few, I am sure. For once at least a great railroad has broken away from the conservative to attract the interest of the public, and it is succeeding. Yes, the New Pioneer Limited, on the Chicago, Milwaukee and St. Paul Railroad, running between Chicago and the twin cities, has done something in the decorating of its equipment that will make hundreds and hundreds of people talk for many months to come. Other railroads will follow suit and before long we will be wondering why any railroad ever used black for this purpose.

By no means has color been entirely ignored in the past. However, this is not true of color harmony. The color combinations that were used in clothing, automobiles, and even house furnishings three years ago are now out of date and could not be marketed today. Education of the public in pleasing dress combinations has brought some remarkable changes in the textile lines and these are likely to be followed by changes in practically every line.

Decorative Details are gaining the attention of executives as never before. We now find them looking up at the unsightly spots on the walls of their otherwise nicely furnished offices—I refer to the common black finished ventilating fan that has a place in almost every office in the country. Here is a beautiful example of what manufacturers may do to increase production and keep down costs. For years these manufacturers have substantially refused to furnish ventilating fans in any finish other than black, except at a very great increase in price. The effect of the position they have taken, no doubt innocently, seems to be that all of the business that has been built up on such selling points as low current consumption; better design; superior workmanship, and so forth, would be lost by the roadside should some entirely new manufacturer suddenly come into the market with an equally well designed line of ventilating fans *colored* to meet with the customers' wishes.

HOME FURNISHINGS are turning to colors in a mad masquerade to win the favor of homemakers. White tablecloths are no longer stylish, except, of course, on formal occasions. Think of the hours and hours that our mothers spent washing and ironing the long white cloths, for the cover for all meals had to be snowy-white.

Now, pastel shades of blue, pink, and green are used—white is no longer considered up-to-date for informal meals. This would not be worthy of special mention were it not for the fact that it is like throwing a bomb shell into the dining room. New colored dishes must be purchased to harmonize with the new table cover. Even the food that is served has to harmonize with the dishes and the colored table cover—all of which presents a wonderfully pleasing dining table appearance that not only makes for good humor at the table but even aids digestion.

THE REWARD exists and it is paid to individuals who persevere in the knowledge of color just as it exists and is paid to those who love and study music, for back of it all lies the fact that new business is constantly being created. Old things are cast into the discard, never to be reclaimed—all because of a new color harmony interest that has been revived in the world within the last few years. It was present in Shakespeare's time, no doubt, for there are very few color discords to be found in the historic records that are handed down to us from that time.

"All the world's a stage," and on that stage Mother Nature has made no color discords. Where discords do appear, they have been made by the hand of man, and their extent—however great that may be—is as a drop in the ocean, when the size of the stage is compared to the total of all the discordant color-effects on this world-stage.

"All the men and women merely players," but there are many differences between their talents and their appearances. Stand on the corner and watch the procession go by; here, a poor workman dressed in subdued colored overalls in keeping with his station in life and not at all out of color harmony with anything he possesses; there, a factory flapper dressed in loud colors that would be perfectly in color-tune were it not for the purple stockings that really belong to her other ensemble suit; here, a colored gentleman with a yellow tie and red socks; there, an attentive mother very finely dressed in black and absorbed in her pretty, golden-haired, blue-eyed child dressed in shoes, stockings, dress, coat, and bonnet, all colored in delicate shades of lilac—need I go on to prove to the reader that the little girl with golden hair stands out in the crowd like a shining star in the heavens—a tribute to the thought and the study and the care of that little mother who wants her daughter to be just a little better than any other child in the world—a wish that is apparently going to be realized because of the part she allows color to play in her life.

Truly, there is a very close relation between color and the business of today.

INDEX

A

Advertising
  poor returns from 102
  use of saturated colors in 12
Advertising appropriations 93-94
Alizarine lake 84
Aluminum bronze 80
Amateur photography 59
Amber glass 51
American flag, color story of the 66-67
American vermillion (Color L) 88
Antwerp blue 78
Arc, violet-carbon 91
Arrow
  base color 22, 38
  complementary 22, 23, 26, 47
  pivoted 128
Associated combinations 35
Automobile, influence of color in the selection of an 105

B

Base color arrow 22, 38
Berlin blue 78
Black, not a color 18
Blue lead 84
Blues
  Chinese 78
  Cobalt 78, 80
  French 79
  Lapis lazuli 79
  Milori 78
  New 79
  Permanent 79
  Prussian (Color A) 78, 82
    Antwerp 78
    Berlin 78
    Iron 78
    Saxon 78
    Steel 78
    Turner's 78
  Robin's-egg 19
  Ultramarine (Color B) 79-80
Bluing 78
Brazil wood 84
Bremen green 81
Brightness 11, 13
  measured 14
Brightness cylinder 10, 15-18
Brilliancy 10
Broadcasting stations, wave length of 6, 7
Bronzes
  aluminum 80
  copper 80
  golden 80
Browns
  Cassel earth 81
  Cologne earth 81
  metalic 80
  mineral 80
  sap 81
  sepia 81
  Vandyke (Color C) 81
Brunswick green 81
Buckingham Memorial Fountain 54

C

Camera, the eye of the 59
Carbonate, lead 80
Cassel earth 81
Chinese blue 78
Chinese vermillion 88
Chromate of lead 89
Chromatic circle 14, 15
  photographs of the 60
Chromatic cylinder 18
Chrome green 81, 82
Chrome red (Color L) 88
Chrome yellow 82
Chrome yellow 89
  medium (Color M) 89
Circular scale 11, 26, 42-45
Clothing, color education in 4
Cobalt blue 78, 80
Cologne earth 81
Color
  a new use for 106
  and business 99-109
  and musical notes 5
  family tree of 18, 19
  of factory piping 70-73
  proportion 39
  theories of 4
  three general characteristics of 11, 13
  weathering of a 96
  what it includes 10, 11
Color art of the future 48
Color blindness 25
Color chart in colors 128
Color choosing 22-27
  chart 22, 64-66, 128
Color circle 12, 14
Color code
  for factory piping 71
  for factory surfaces 74
  for pairs of telephone wires 73, 75
Color combinations 3
  discordant 3
  legibility of 23, 24
    sequence of 37-39
Color designation 70-76
Color education 4
Color filters 60
Color grouping 31
Color harmony 12, 35-41
  associated 36
  one-color 36
  true complementary 36
Color language 62-69
Color matching 42-45
Color mixing 23, 28-34, 46-48, 51
Color photography 58-61
Color pigments 77-90
Color range 24
Color spectrum 3, 9, 15
  ocular 8
  visible 8
Color standardization
  for factory equipment 73, 74
  for factory surfaces 74
  for sprinkler heads 73, 75
  see also Color code

Inclosed find FIFTY CENTS for which please send postpaid to the address given below—

1. FINISHING RESEARCH COLOR DECK of 77 colors, size 4″ x 1½″, which includes two shades and two tints of each of the twelve spectral colors, as well as other samples of color.

*Name*____________________ *Date*________________*1928*

*Address*____________________ *Position*________________

*City*____________________ *State*________________

PRACTICAL AUTOMOTIVE LACQUERING

VOLUME II

of the Practical Finishing Series
will be ready soon.

We desire to have on file the names of all our readers so that they may be advised from time to time of new developments and available publications on Finishing. If you would like to have your name on such a list, kindly fill in the following:

I am particularly interested in ☐ Automotive Lacquering
☐ ________________

*Name*____________________ *Date*________________*1928*

*Address*____________________ *Position*________________

*City*____________________ *State*________________

Finishing Research Laboratories, Inc.
1168 West Twenty-Second Street
Chicago, Illinois
U. S. A.

INCLOSE IN AN ENVELOPE WITH FIFTY CENTS IN STAMPS

POST CARD
THIS SIDE FOR ADDRESS ONLY

PLACE
TWO CENT
STAMP
HERE

Finishing Research Laboratories, Inc.
1168 West Twenty-Second Street
Chicago, Illinois
U. S. A.

- Color story of the American flag 66-67
- Color terminology 13-14
- Color testing 91-98
- Color treatment, photographic
  - effects of 58-50
- Colored lighting 46-57
  - an automobile salesroom 50
  - apparent effects of 50, 57
  - caution 46
  - dimming 52
  - in the home 53
  - in the theater 5, 101
  - mixtures 30, 47, 51
  - of exteriors 5, 54
  - reflectors 52
- Colored locomotives 106
- Colored ventilating fans 106
- Colors
  - analine 33
  - basic 4
  - changes in 4
  - complementary 12
  - cool 31
  - dark 17
  - dead 12
  - dyestuff 74
  - eggshell 12
  - fading 25-26, 94
  - fugitive 79, 84, 94
  - light 17
  - lithographic 93
  - popular 19-21
  - preference of 104
  - primary 14, 15, 18, 20
  - prismatic 6
  - quaternary 20, 21
  - rules for mixing 31-33
  - saturated, and advertising 12
  - secondary 14, 15, 18, 20
  - selection of 26-27
  - subdued 12
  - tertiary 18, 19, 20
  - that do not photograph well 61
  - tinting 29
  - warm 26
- Combinations
  - color 3
    - discordant 3
    - harmonious 41
  - three-color 39
- Complementary arrow 22, 23, 26, 45, 47, 128
- Complementary colors 11-12, 45
- Copper bronze 80
- Cromatic cylinder 18

D

- Decorative details 106-107
- Diagonal arrangement 49
- Diagonal theory 40
- Dress, color education in 4
- Dyes 33
- Dyestuff colors 83, 94

E

- Electric waves, velocity of 6
- Emerald green 83
- Emeraude green 82
- Enamels, colored baking 32, 34

F

- Factory paints, color code for 74
- Factory piping, color code for 70-73
- Fading of colors 25-26
  - dress goods 94
  - dyed textiles 95
  - housefurnishings 95
  - printing and lithography 94
  - yarn 94
- Fadometer, the 92
- Fastness of colors 91-92
- Filters, color 60
- Flood lighting 54
- French blue 79

G

- Gold bronze 80
- Green
  - Bremen 81
  - Brunswick 81
  - chrome 81
  - emerald 83
  - emeraude 82
  - irridian 82
  - ultramarine 80
  - verdigris 83

H

- Holidays, colors that signify certain 48
- Homes, colored light in 52-54
- Harmony, color 35-41
- Harmony table 37
- Harmony triangle 22, 26, 38, 128
- Housefurnishings, color education in 4, 107
  - fading of 95
- House painting 80
- Hues 4, 10, 11, 12, 13, 14

I

- Identification of factory pipes 71
- Indian red 84
- Inks 33
- Iron blue 78
- Irridian green 82

K

- Kinds, harmony 36

L

- Lacquering buildings 98
- Lacquers 3, 57, 97-98
  - clear 57
  - sprayed 128
- Lake
  - alizarine 84
  - carmine 83
  - madder (Color E) 83
  - rose 84
  - scarlet 83
- Lamps, mercury arc 56
- Language of colors 62-69
- Lapis lazuli 79
- Lead
  - blue 84
  - red (Color D) 74, 84

Lead carbonate 80
Lead chromate, scarlet 58
Lead sulphite 80
Legibility of color combinations 23, 24
Lighting, colored
  see Colored lighting
Lithographic colors 93
Lithol red 85
Luckiesh 13
Lustre 12

M

Machine, weathering 96
Madder lake 83
Maps, and the color language 68
Matching, color 42-45, 128
Mercury arc lamps 56
  apparent colors under the 57
Milori blue 78
Mineral brown 80
Minium 84
Mixing triangle 28-29, 128
Music, colored light and 55-56

N

Names, harmonious combinations of 41
National Fire Protective Association 73
Nesbit, Wilbur D. 66, 67
Neutral color 128
New blue 79
Newton, Sir Isaac 5, 6

O

Ochre
  yellow 89
  golden 90

P

Paints 33
Para red 85
Pastel hue 12
Perfume lights 53
Permanent blue 70
Photographic plates, kinds of 60-60
Photography, color 58-61
Pigment mixtures 46-48
Pigments
  color 77-90
  spectral difference of 48-49
Piping, factory, color code for 70, 71
Plant life, movements of 7
Popular colors 19-21
Primary colors 14, 15, 18, 20
Primary triangle 13, 14
Prismatic colors 6
Procedure in choosing colors 22
Prussian blue 78-79, 81, 82

Q

Quaternary colors 20, 21
Quicksilver vermillion 88

R

Radiation, ultra-violet 93
Radio sets, colored wiring of 76
Red
  Indian (Color F) 84
  Lithol 84
  Para 85
  Toluidine 85
  Tuscan 85
  Venetian (Color G) 85
Red lead 74, 84
Robin's-egg blue 19
Rose doré 83
Rose lake 84
Rose madder (Color E) 83
Rose pink 84

S

Sap brown 81
Saturation 11
  how it is measured 13
Saxon blue 78, 79
Scale
  circular 11, 26, 42-45
  color 63
  vertical 11
  wave-length 7, 8
Secondary colors 14, 15, 18, 20
Sepia brown 81
Shakespeare 99-100
Shade 10, 17, 65
Show windows, colored lighting in 49-51
Sienna
  burnt (Color H) 86
  raw (Color I) 86
Signs, legibility of 22
Spectrum 3, 9, 15
  actinic 9
  chemical 9
  chromatic 9, 64
  color 15
  invisible 9, 64
  ocular 8, 9, 64
  visible 8, 9, 64
Spectrum colors 3, 10, 15
Spray-gun, lacquered with a 128
Sprinkler heads, color
  standardization for 73, 75
Steel blue 78
Stencil, spraying lacquer through a 128
Sulphite, lead 80
Sunlight, standardized 96
Sunshine color 128

T

Telephone wires color code for pairs of 73, 75
Terminology, color 13-14
Tertiary colors 18, 19, 20
Testing color 91, 98
  samples 96
Textiles, dyed, fading of 95
Theaters, and colors 51-52, 101-102
Tint 10, 17, 65
Toluidine red 85

Triangle
  harmony 38
  mixing 28, 29
  pivoted 128
  primary 4, 13, 14
Turner's blue 78
Tuscan red 85

U

Ultramarine blue 79
Ultra-violet radiation 93
Umber
  burnt (Color J) 87
  raw (Color K) 82, 87-88

V

Vandyke brown 81
Varnishes 33
Venetian red (Color G) 85
Verdigris 83
Vertical scale 11
Vermillions 88
Violet-carbon arc 91

W

Wall decorations, color education in 4
Wave length 6-10, 74
  of broadcasting stations 6, 7
  used to measure hue 13, 14
Wave-length scale 7, 8
  chromatic 9
Waves
  and prismatic colors 6
  electric
    velocity of 6
  heat 8
  radio 8
  thermal 8
Warm colors 26
Weatherometer 96
  wind attachment 96
  rain attachment 96
  humidity attachment 96
  refrigerating accessory 96
Weathering of a color 96
White, absence of color 18
White lead 80

Y

Yellow
  chrome 82, 89
  ochre 89
"Your Flag and My Flag" 66, 67

BOOKS OF THE

PRACTICAL FINISHING SERIES

IN PREPARATION

and to be published by the Finishing Research Laboratories, Inc., of Chicago

AUTOMOTIVE LACQUERING

Including Motor Trucks, Busses, and Airplanes, with special attention to cleaning, masking, striping, spraying, and car washing.

JAPANNING AND ENAMELING (*Baked Finishing*)

The first and only book of its kind, dealing with the many methods of application as well as the use of baking materials for finishing.

EXTERIOR OR CONTRACT PAINTING

Covering angles of this part of the painting or finishing industry heretofore untouched. Railroad and structural branches covered. Important estimating information included.

INTERIOR PAINTING AND DECORATING

Dealing with the very latest materials, methods, and equipment and particularly the use of lacquer for architectural purposes.

In addition to the foregoing to be used as reference books there will be:

THE EDUCATIONAL SERIES for schools, colleges, vocational and manual training institutions, consisting of—

COLOR THEORY
WOOD FINISHING
METAL FINISHING
PLASTIC FINISHING
AUTOMOBILE FINISHING

School instruction books that will fill a very important gap in educational literature. Simple, practical, and authoritative as textbooks.

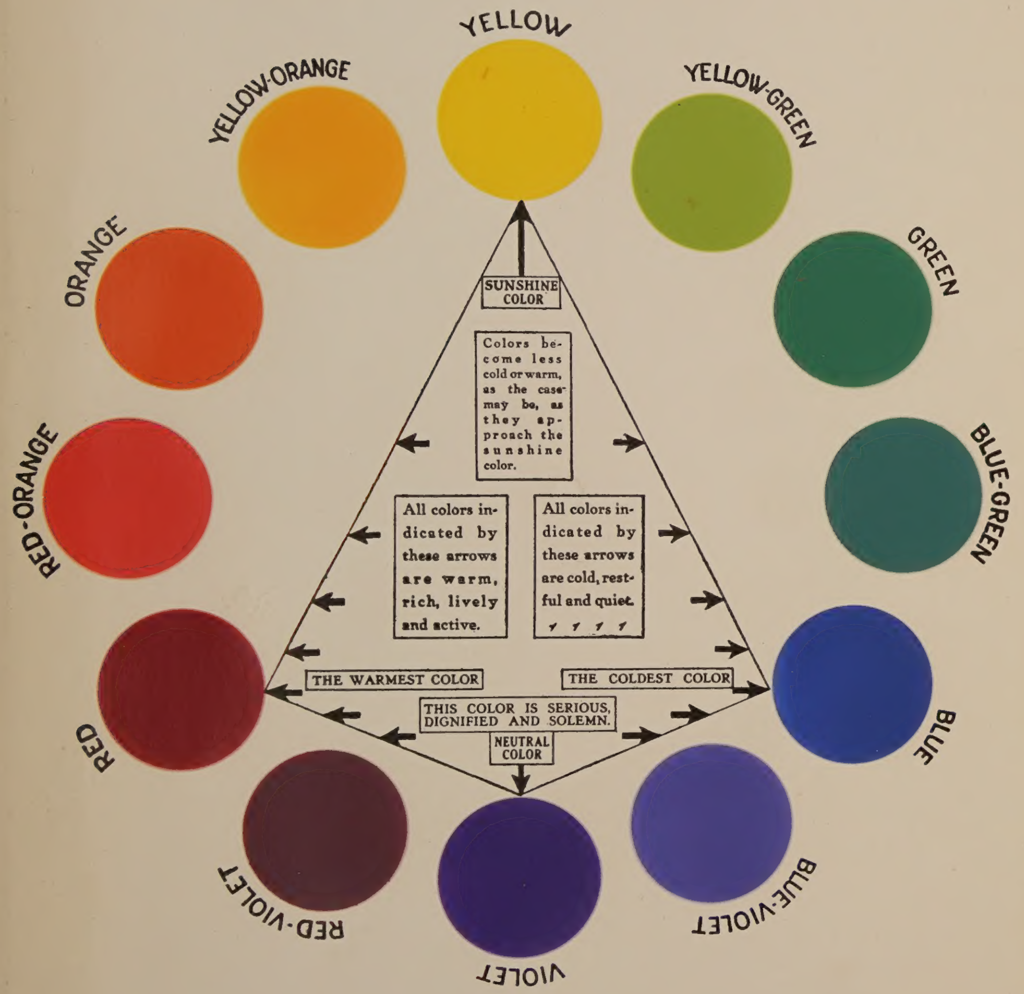
We have for sale and will review any other book on FINISHING and related subjects.

FINISHING RESEARCH LABORATORIES, INC.
Publishers

87-B26830

Nitrocellulose is used as a base in making the following parts of this book:

The artificial leather cover
The celluloid pivoted arrow
The celluloid pivoted triangle
All of the colored spots on this chart



Colors become less cold or warm, as the case may be, as they approach the sunshine color.

All colors indicated by these arrows are warm, rich, lively and active.

All colors indicated by these arrows are cold, restful and quiet.

THIS COLOR IS SERIOUS, DIGNIFIED AND SOLEMN.

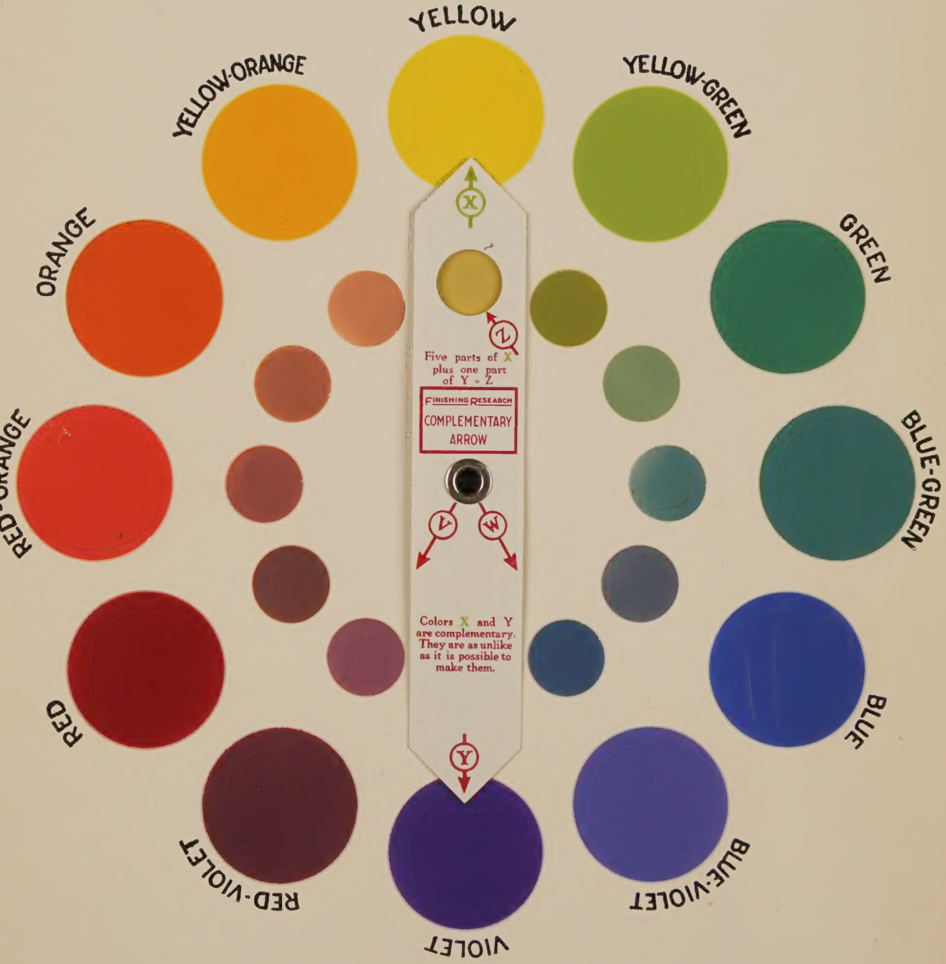
COLOR CHOOSING

See pages 64 and 69 for *COLOR CHOOSING* Directions

Patent Applied For

COLOR PLATE VII

Harmonious colors are designated by RED Arrows, discordant colors by GREEN Arrows



Five parts of X plus one part of Y = Z

Colors X and Y are complementary. They are as unlike as it is possible to make them.

COMPLEMENTARY MIXING

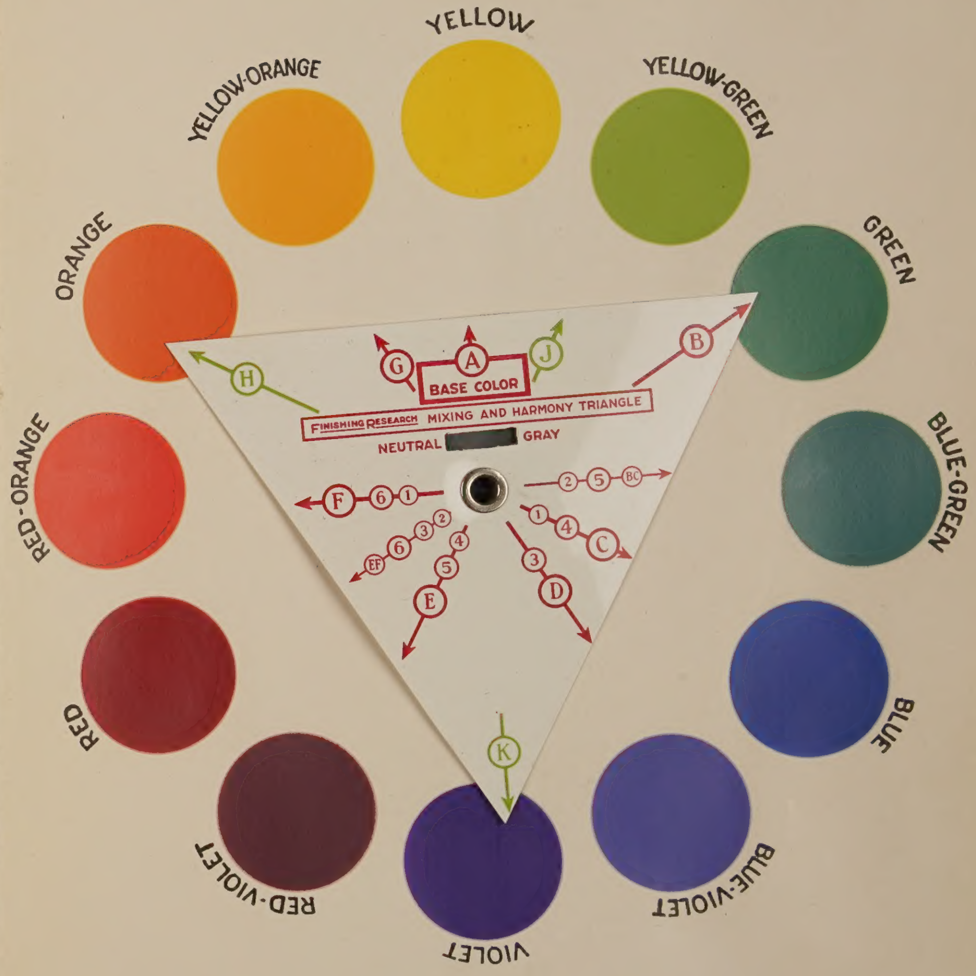
See pages 26, 36, 37 and 45 for *HARMONIZING* Directions

THE

FINISHING RESEARCH

COLOR CHART

EACH OF THE TWENTY-FIVE COLORS ON THIS CHART WAS HAND-MADE BY ACTUALLY APPLYING LACQUER THROUGH A STENCIL WITH A SPRAY-GUN



MIXING HARMONY AND LIGHTING

See pages 18, 28, 29 and 30 for *MIXING* Directions
See pages 22, 26 and 36 for *HARMONIZING* Directions
See page 43 for *COLOR MATCHING* Directions
See pages 50 and 57 for *LIGHTING* Directions

See page 39 for Directions on *THREE-COLOR COMBINATIONS* and the use of the numerals within the red circles on the pivoted triangle above.

Date Due

5-6-44

667.6 M68
80041

GETTY RESEARCH INSTITUTE
3 3125 01093 3931